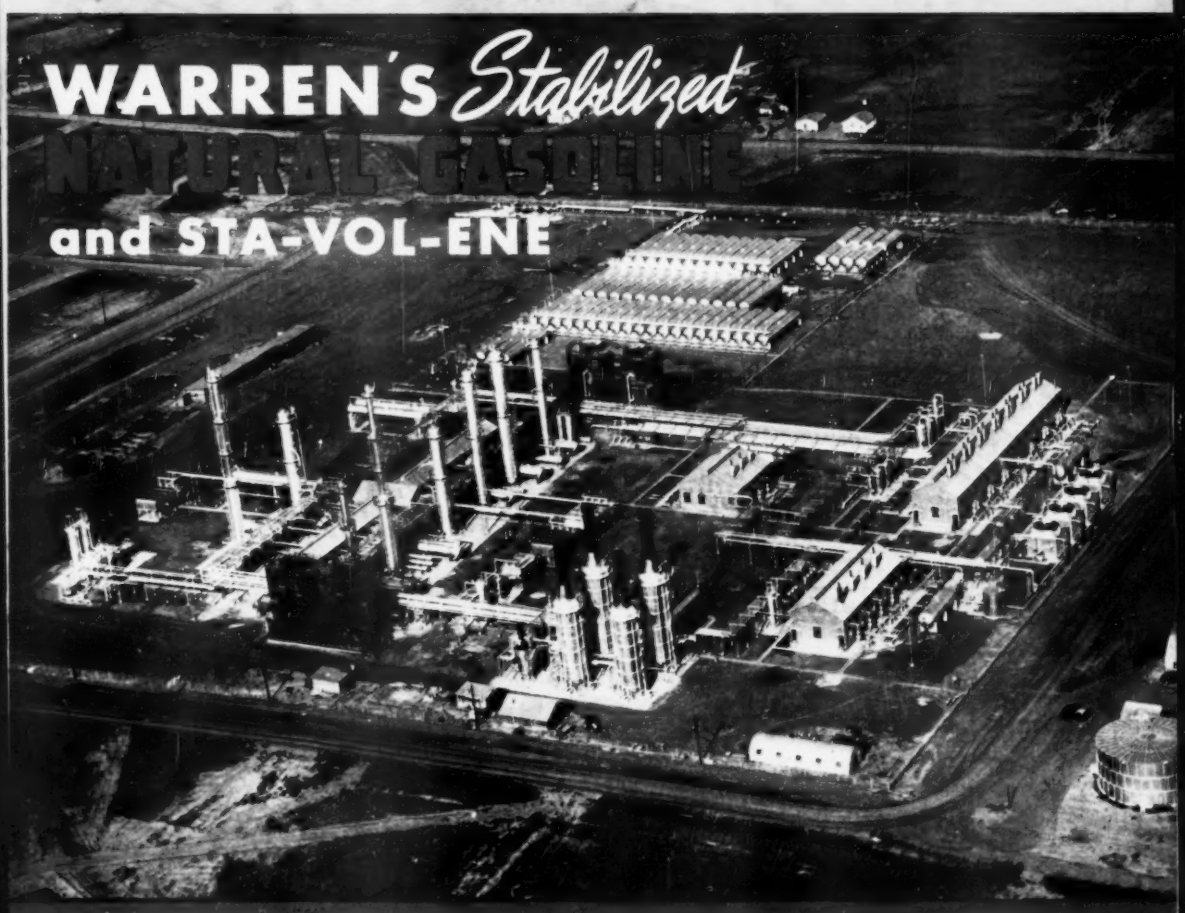
REFINING NUMBER

L AND GAS URNAL

WARREN'S *Stabilized*
NATURAL GASOLINE
and STA-VOL-ENE



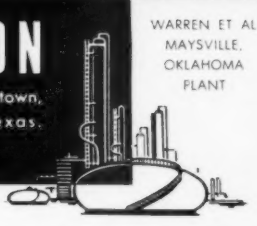
FOR KNOCKLESS — QUICK STARTING — CARBON FREE — UNIFORM MOTOR FUEL

WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

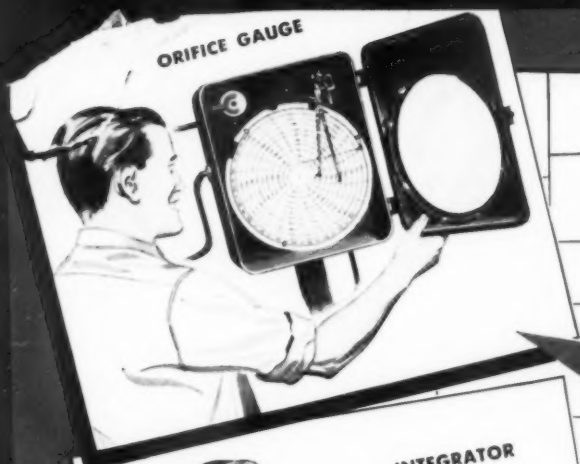
TULSA 2 OKLAHOMA CABLE ADDRESSES: Stavolene, Warren



WARREN ET AL MAYSVILLE, OKLAHOMA PLANT

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

PRICE 50 CENTS TABLE OF CONTENTS PAGE 151 **MARCH 23, 1950**



It's our Move

★ ...TO BRING YOU BETTER SERVICE, BETTER PRODUCTS

ROCKWELL-EMCO

ORIFICE GAUGES AND CHART INTEGRATORS

now to be produced by...

THE MACNICK DIVISION

TULSA, OKLAHOMA

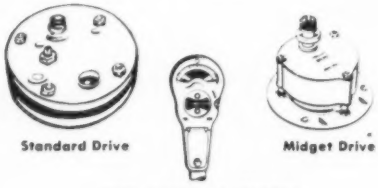
A sizeable portion of instrument production for the Pittsburgh Equitable Meter Division is being moved into the Macnick plant in Tulsa, Oklahoma.

This move is in keeping with the overall Rockwell policy of manufacturing products as close to the market as is practical. The Macnick Division operates in a large modern factory ideally equipped to manufacture precision instruments. Macnick employees are skilled craftsmen with a fine background of instrument-making experience acquired through years of building chart drives, taximeter clocks and parking meters.

With adequate facilities in Tulsa, this move will result in stepped up production of Rockwell-Emco orifice gauges and chart integrators. We can now promise better service, better products to buyers in the busy Southwest area.

Other MACNICK Products

ROCKWELL CHART DRIVES



Standard Drive — Midget Drive

THE PARK-O-METER

Manufactured for and sold by the McGee-Hale Park-O-Meter Co.

Pittsburgh Equitable Meter Division

ROCKWELL MANUFACTURING COMPANY

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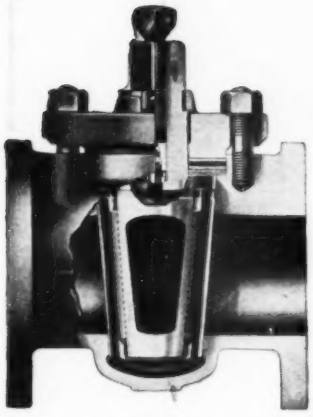
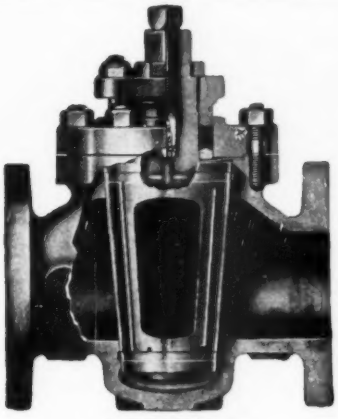
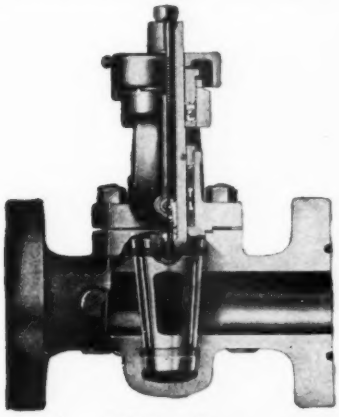


Single Gland Type



Regular Gland Type



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Acids... Solvents... Sludges...

and other troublesome liquids—

USE WALWORTH LUBRICATED PLUG VALVES

When handling acids, condensates, dyes, oils, solvents, solutions, slurries and hundreds of similar "troublesome" liquids, you get better control, more dependable service and lower operating costs with Walworth Lubricated Plug Valves.

These valves have proved their ability to give easy operation . . . fast action . . . tight shut off . . . greater protection against corrosion. Turning is smooth and easy; just a ¼ turn from full-opening to full-closing. Moreover, Walworth Lubricated Plug Valves are tightly sealed against leaks — *whether open or shut.*

Walworth Lubricated Plug Valves are available in sizes ½" to 24" for pressures from 125 to 5,000 psi, and for vacuum requirement. For further information about Walworth's Complete Line of Lubricated Plug Valves, see your Walworth distributor or write for Catalog No. 46L.

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As easy as the "ZC"

● As easy-starting as the Fairbanks-Morse "ZC" Engine is an old oil field proverb. The proverbial easy starting of the "ZC" in any weather is one of the big reasons why they're the oil field favorites. The "ZC" is easy to maintain and operate . . . easy on the pocketbook, too! Trouble-free vapor cooling, self-oiling, extra heavy flywheels that assure smooth, power-saving operation are but a few of the many "ZC" features that assure better pumping service. Fairbanks, Morse & Co., Chicago 5, Ill.

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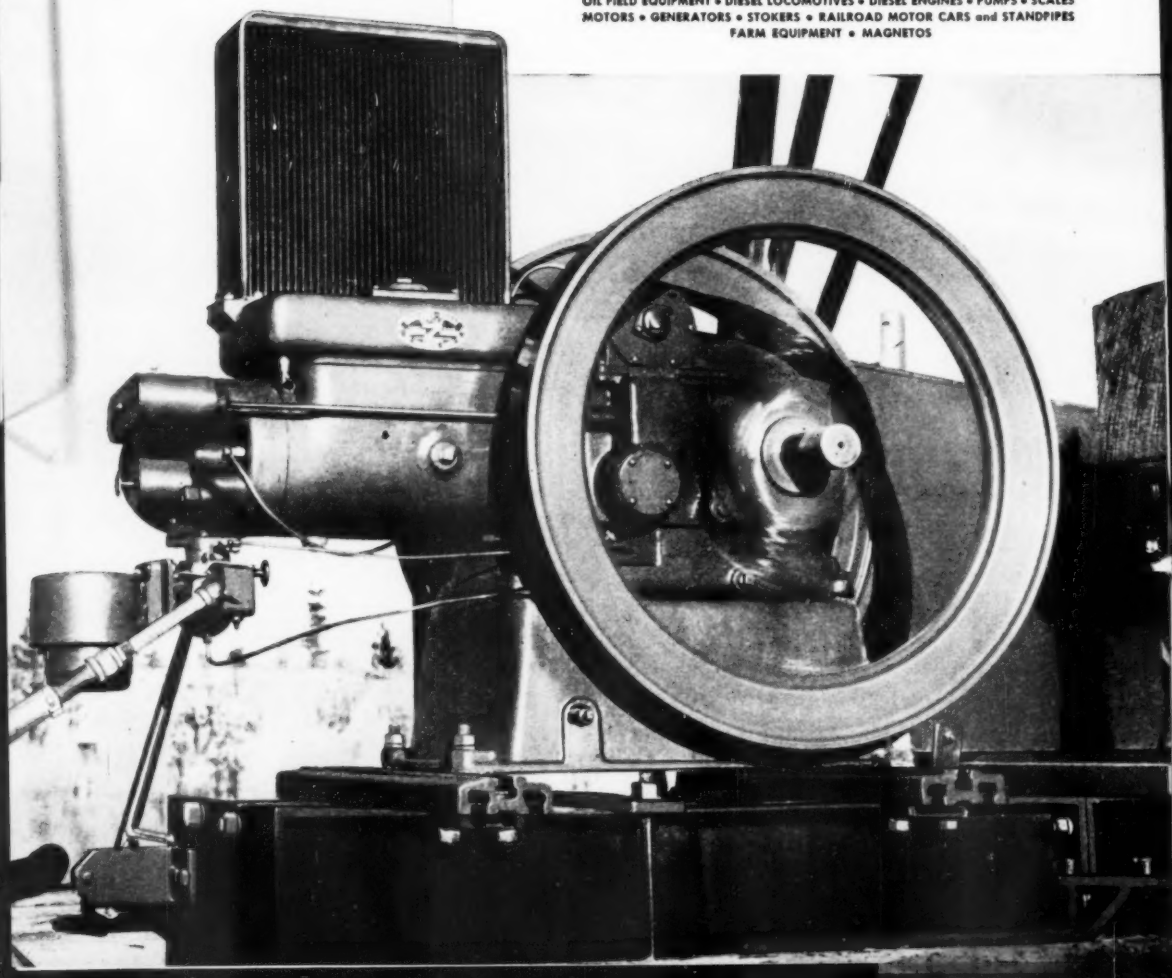

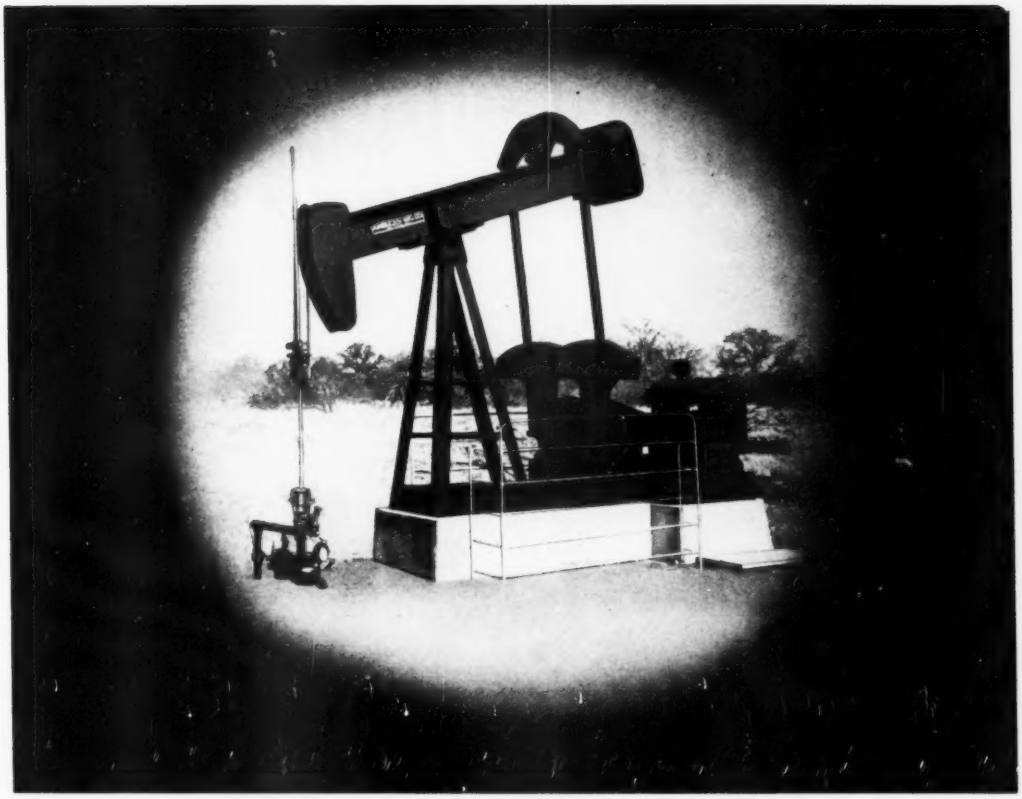

Pumping Costs Less
... with AMERICAN Pumping Units

Contact your favorite supply store or the nearest American office NOW.

The more wells you have on the pump, the more you can save by using efficient AMERICAN Pumping Units. You get highest efficiency on each well by choosing exactly the right American Unit from 14 combinations of structure and reducer sizes. You get longer service with less servicing, because every American Pumping Unit is engineered to A. P. I. Specifications throughout, and built to pump year in year out with a minimum of maintenance.

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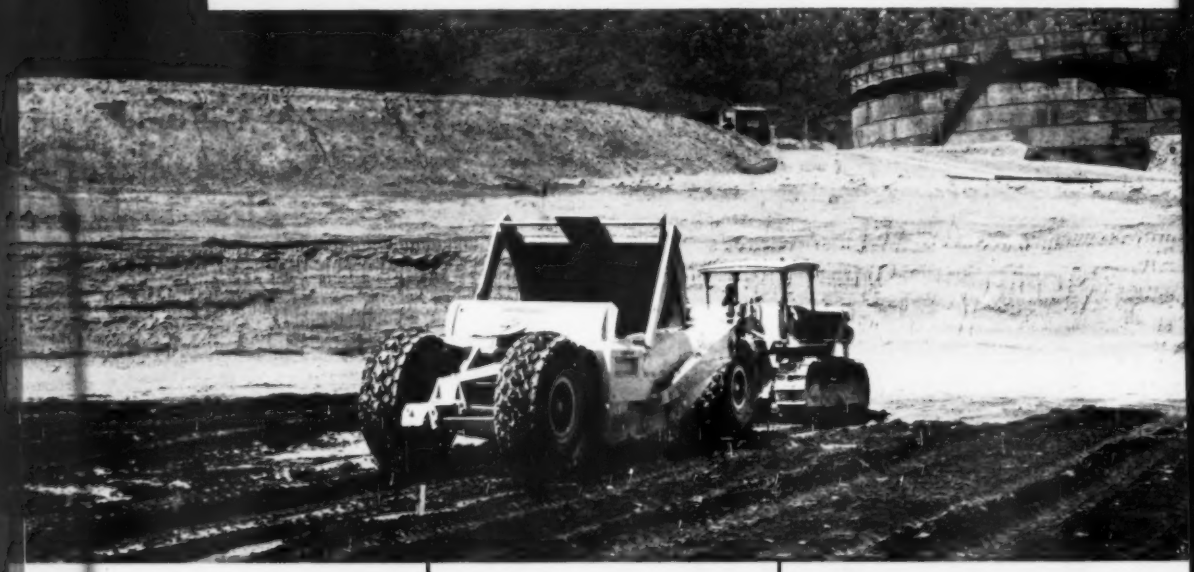
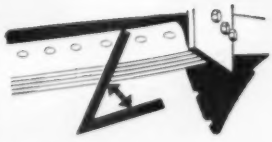
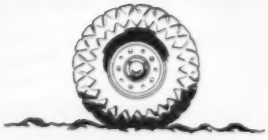
BOOST PRODUCTION





EASY LOADING

Blade angle and design are two points that contribute to good or bad loading characteristics. The tough "Caterpillar" blade is set to shear hard-to-dig material, then direct and guide it into the loading chute. With 3 inches of special hard facing alloy deposited on these cutting edges, the user is assured of a blade that sharpens to a keen edge.



BIG TIRES . . . MORE TRIPS

When ground conditions deteriorate, air pressures are usually reduced to keep tire penetration at a minimum. The big and oversize tires used on "Caterpillar" Scrapers are able to have their pressures greatly reduced without overloading. That means they stay on top, roll more easily, allow hauling in higher gears and aid in piling up real yardage records.

'DOZER-TYPE EJECTION

'Dozer-type ejection rolls sticky clay out of the bowl with ease and precision. Typical of "Caterpillar" finely engineered design are the ejector plate guide rollers. These heat-treated rollers are mounted on adjustable eccentric shafts so that proper clearance may always be maintained between bowl sides and ejector plate. Binding or rubbing problems are eliminated.

CATERPILLAR

REG. U. S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS

AND CUT COSTS

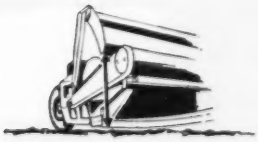
with "CATERPILLAR" SCRAPERS

WHEN the chips are down, you can count on a husky "Caterpillar" Scraper to come through for you. Stamina is built into every inch of its hide to stand terrific punishment. Its finely engineered design enables it to speed through jobs that slow down ordinary units. Pair it with its matching "Caterpillar" Diesel Tractor, and you've got a team that saves you money two ways—in higher production and lower maintenance costs.

Here on the Sinclair Oil & Refining Company's mountainous El Chaure Field near Puerto La Cruz, Venezuela, big cuts and fills are needed for building sites for 80,000-barrel-capacity tanks. This "Caterpillar" No. 80 Scraper rated at 18 heaped yards and its matching D8 make an ideal team for the job. First a No. 12 Motor Grader blades an oil mix into an 1800-ft.-long windrow. The Scraper then picks up this bituminous material and spreads it on the tank site as a foundation mat. Next the tank bottom is placed on the mat, which serves as insulation against the region's acid soil.

You can't talk quality into a machine. You've got to build it in—take a look at the "Caterpillar" Scraper's features and you'll see why this big yellow slugger really rates with men who know earthmoving. Better still, call your nearby "Caterpillar" dealer today for information and a demonstration!

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

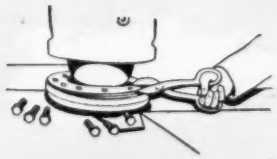


GOOD APRON DESIGN

"The sky is the limit" when raising the aprons on "Caterpillar" Scrapers. Open-top scraper design combined with long apron arms located outside the bowl assure the free ejection of heaping sticky loads. When ejecting fine materials such as sand, the maximum apron height can be reduced to provide a smooth spread with no gaps.

ENGINEERED CABLE SYSTEM

The entire "Caterpillar" cable control system is finely engineered to give constant easy performance. Accurately aligned heat-treated sheaves prevent cable chafing and minimize power drain on the tractor engine. All cables are shielded against abrasive materials, yet one man can easily thread the entire unit while keeping both feet on the ground.



LOW MAINTENANCE COST

Typical of "Caterpillar" in-built quality is the ball and socket joint connecting gooseneck to front axle. The ball is induction hardened with a tough center to withstand both wear and breakage. Spherical design enables the scraper to be maneuvered into extreme positions without binding. Shims are removed as wear occurs and a bronze liner rides between ball and socket to prevent steel-to-steel contact. Lubrication is through a single Zerk fitting.

DIESEL

EARTHMOVING EQUIPMENT

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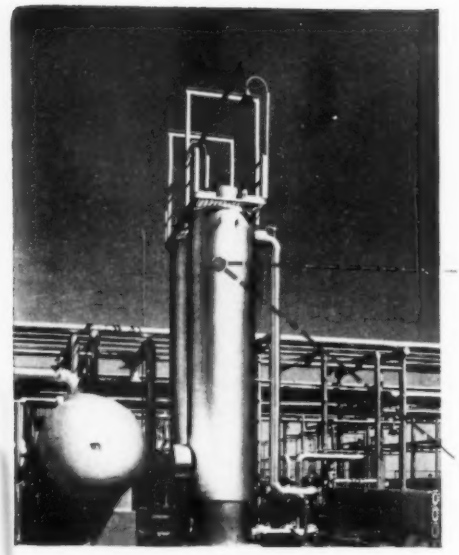
Box OG-3, Peoria, Illinois
Send me, without obligation, booklet,
"'Caterpillar' Scrapers Are Profit Makers."

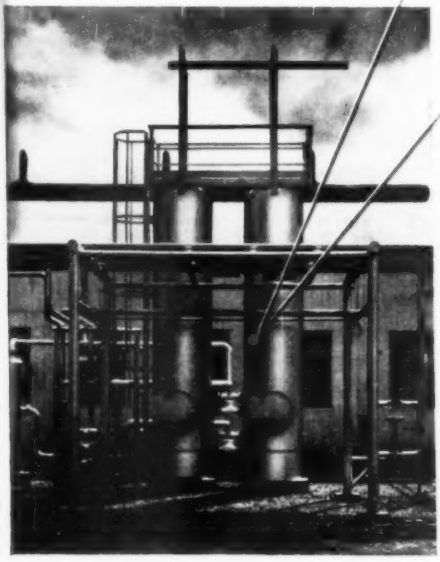
Name _____

Address _____



LIQUID DEHYDRATION UNIT

Each tower is charged with 1590 lbs. of ALCOA *Activated* Alumina. Approximately 240,000 gallons of liquid hydrocarbons are dried daily to a dew point of minus 40° F. Liquid enters the towers at 90° F. and 390 psig. Reactivation on an 8-hour cycle with liquid hydrocarbons heated to 450° F.



AIR DEHYDRATION UNIT

Approximately 100,000 cubic feet of air entering the towers at 80° F. and 50 psig, are dried to *minus* 40° F. dew point daily. Each tower contains 5900 lbs. of ALCOA *Activated* Alumina. Air, heated to 450° F., regenerates the alumina on a 16-hour cycle.

both AIR and LIQUID dried to **minus 40° F.** with ALCOA Activated* Alumina

These drying units were designed for the Maysville, Oklahoma, unit of the Garvin County Plants, operated by Warren Petroleum Corporation for itself and four other owners. ALCOA *Activated* Alumina was selected as the desiccant to do the job because it dries *both* liquid and air quickly, efficiently and economically.

ALCOA *Activated* Alumina is a commercially pure, highly inert adsorbent that has high resistance to crushing, shock and abrasion. It does not soften, swell or disintegrate even when immersed in water. It can be reactivated an almost unlimited number of times with no appreciable effect on efficiency. This, coupled with its relatively low initial cost, makes ALCOA *Activated* Alumina a most economical drying agent.

Let us send you complete information on this reliable, versatile desiccant. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 618c Gulf Building, Pittsburgh 19, Pa.

*Reg. T. M., *Aluminum Company of America*

Alcoa Chemicals

ALCOA

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ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS. ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

cut threads

BETTER
FASTER
CHEAPER

1. LANDIS DIE HEADS cut tool cost by using chasers that are independent units. Worn or damaged chasers are reground or replaced *individually*, without affecting the remaining chasers of the set.

2. LANDIS DIE HEADS reduce tool inventories by cutting *both* right- and left-hand threads with a *single* set of chasers. Chasers are ground on both ends, the spring action in the die head is reversed, and either a right-hand or left-hand set of chaser holders is used.

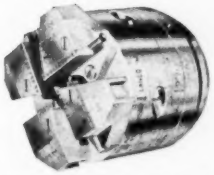
3. LANDIS DIE HEADS cut all diameter threads with a constant pitch and form within the rated range of the die head with a *single* set of chasers. Short thread lengths larger than the rated diametrical range can be cut with the *same* die head equipped with over-size chaser holders.

4. LANDIS DIE HEADS use chasers that can be reground to 80% of their length. Regrinding is a simple operation restoring the entire cutting edge and leading feature, yet retaining the initial accuracy of pitch, diameter, and depth of cut.

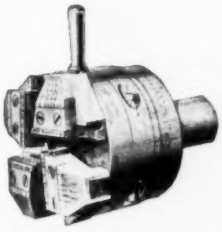
5. LANDIS DIE HEADS improve thread finish and cut production costs by reducing chaser wear and breakage. The tangential position of the chaser to the work allows lateral absorption of cutting strains. Resulting reduced friction and vibration make higher cutting speeds possible without causing thread distortion or chaser breakage.

6. LANDIS DIE HEADS consistently produce threads accurate for lead. Regrinding does not destroy the lead controlling feature of the chasers. Thus this feature assures accurate pitch threads throughout the chaser's life.

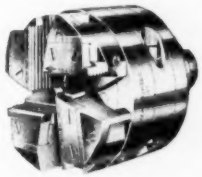
7. LANDIS DIE HEADS are built to stay on the production line. Tough, high-carbon steel is used in all parts. Rigid construction maintains accuracy, and minimizes wear of working parts. Landis Die Heads are furnished in two models, heat-treated or hardened-and-ground, depending on the application and quality of thread desired.



LANCO—a revolving die hand for hand-operated, semi-automatic, and automatic threading machines.



LANDMATIC—a stationary die head with self-opening action for turret lathes.



LANDEX—a revolving die head for automatic screw machines and other "live spindle" machines.

LANDIS Machine COMPANY

WAYNESBORO • PENNA.

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

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Consolidated Safety Relief Valves are "standard throughout" the vast new storage tank installations of the Warren Petroleum Corporation at Maysville, Oklahoma. And for the best of reasons . . .

These modern safety relief valves incorporate important . . . ***and exclusive*** . . . extra safeguards plus continued performance at rated capacity. The fixed capacity of every Consolidated Safety Relief Valve is ***built in***. This means these valves do not depend upon the position of multiple adjustable blowdown rings . . . cannot be accidentally altered during maintenance. One adjustment controls blowdown only, without disturbing lift or secondary annular orifice area.

The outside bevel seat and floating guide construction eliminate leakage under discharge piping stresses. Maximum tightness assured for all conditions of operation.

Simplicity of design (25% fewer parts than ordinary valves), reduces maintenance and minimizes standardization problems.

Be ***doubly*** sure . . . of safety for plant and personnel . . . efficiency and economy in operations . . . by specifying only Consolidated Safety Relief Valves.

For complete information, see your local distributor

CONSOLIDATED SAFETY RELIEF VALVES

A Product of

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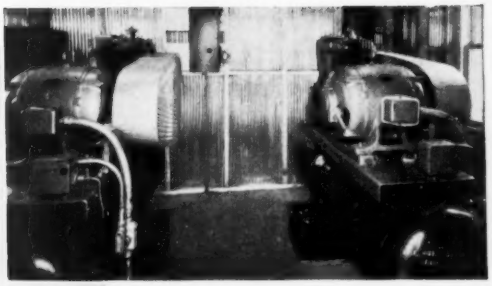
Makers of 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.



Above—Two 10 horsepower Century squirrel cage motors driving air compressors.

At left—7½ horsepower Century splash proof motor driving a pumping unit.

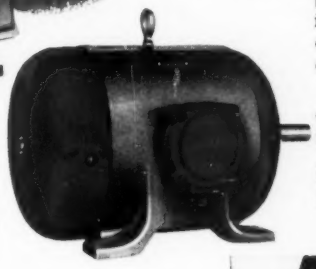
Century MOTORS for the Oil Industry Assure Dependable, Economical Operation

Subjected to rain, snow, sleet and hail thousands of Century Splash Proof Type SCT High Torque High Slip Motors are operating producers' pumps—many for 18 years.

The high slip of the Century type SCT motor saves wear and tear on equipment because it slows down and cushions the impact of the peak load and reduces the sudden shock and its damaging effect.

Century builds a wide range of electric motors, in sizes from 1/6 to 400 horsepower, for oil producing and refining operations. Popular types and standard ratings are generally available from factory and branch office stocks.

Specify Century motors for all your electric power requirements. See your regular supply store.



Illustrating Century splash proof and explosion proof motors.

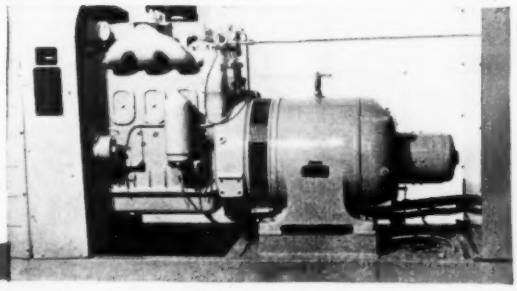
Century C MOTORS

CENTURY ELECTRIC CO.
1806 Pine Street • Saint Louis 3, Missouri
Offices and Stock Points in Principal Cities

-620

Century Type ARC Generator

Where public service current is not available, Century Generators will provide adequate, continuous electric power. Depending on the load per motor and the size of generator, from 10 to 30 wells can be operated from one generator. They provide a dependable source of oil field power.



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To supply the specialized needs of the petroleum industry for corrosion-resistant stainless steels and stainless steel products, your Metal Goods warehouse carries a large stock of these essential specialty metals. Many different grades and types can now be furnished from stock—without delay. A few of these are:

Type 316 for higher corrosion resistance under reducing conditions.
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Sheets • Plates • Bars • Tubes • Castings • Fittings

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Types for special applications, although not normally stocked in warehouses, can also be supplied by us at no extra cost.

Metal Goods warehouses are strategically located in the heart of the Midwest and Gulf Coast refining industry — ready to serve you quickly and dependably.

Monel* • Nickel* • Inconel* • Aluminum • Brass • Copper

Plus complete stocks of condenser and heat exchanger tubes... Admiralty... Alclad Aluminum... 70/30 Super-Nickel... Monel.

Tube Sheets... Naval Brass... Muntz Metal

Fittings and Accessories

*Not Warehoused in Kansas City or St. Louis

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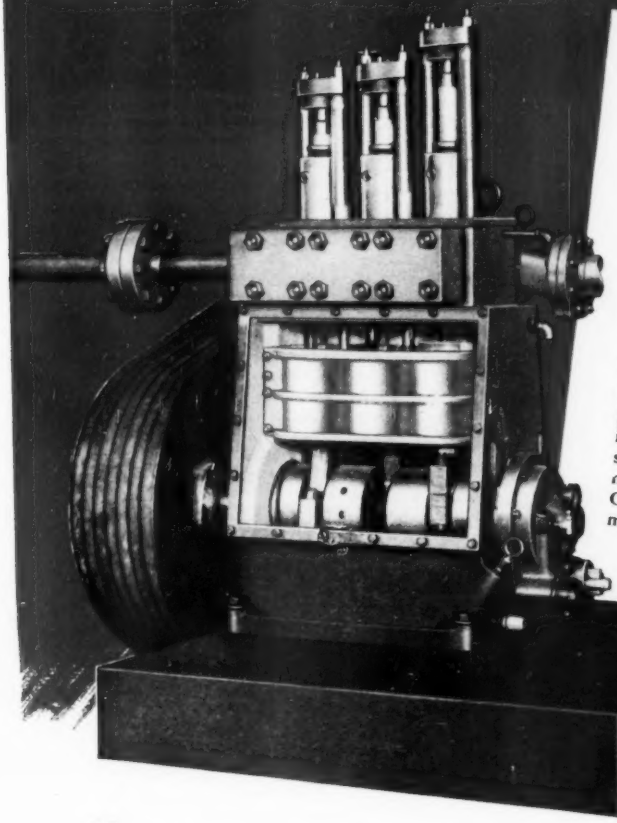
It's New!

Aldrich 5" Stroke Direct Flow Pump Series



New in design, the Aldrich 5" Stroke Direct Flow Pump features, besides many distinct advantages, a *new low in price.* Built in standard Aldrich series with 3, 5, 7 or 9 cylinders, these pumps range from 100 to 275 hp and handle almost all liquids encountered in oil field and petroleum service.

The fluid-end on the new 5" series consists of a *sectionalized* assembly—of distinct advantage in handling corrosive liquids. When necessary, specific sections can easily be replaced—*at a fraction of the cost of an entire end unit.* Design of this fluid-end permits easy maintenance and interchangeable plunger sizes—without removing stuffing box liners. Throughout this 5" series all wearing parts other than main bearings are interchangeable. Close clearances provide high volumetric efficiency in handling light as well as heavy liquids.

Here is a pump, at a new low in price, designed for economy, reliability, accessibility and low maintenance. Send for Data and Specification Sheets for full details on how a new Aldrich 5" Stroke Direct Flow Pump can assure you *better* service and *improved* economy. Write today:

Representatives: Birmingham • Bolivar, N. Y. Boston • Chicago • Cincinnati • Cleveland Denver • Detroit • Duluth • Houston Jacksonville • Los Angeles • New York • Omaha • Philadelphia • Pittsburgh • Portland, Ore. Richmond, Va. • St. Louis • San Francisco Seattle • Spokane, Wash. • Syracuse • Tulsa

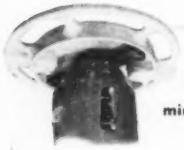
THE ALDRICH PUMP COMPANY

9 GORDON STREET, ALLENTOWN, PENNSYLVANIA

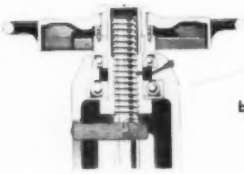
All Aldrich Pumps Have **STAYING POWER**

You get all these features in

THESE WERE EDWARD FIRSTS!



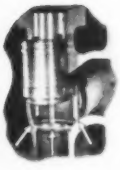
IMPACTOR* HANDWHEEL
Maximum closing torque in minimum space. An all time high in valve design.



EVALTHRUST* YOKE BUSHING Patented ball bearing construction for easy valve operation.

CLOSURE INDICATORS
No guessing if valve is tightly closed for either regular operation or for special tests.

LOW PRESSURE-LOSS BODY CONTOURS
Both globe and angle bodies let maximum flow through. Pioneered by Edward. Copied but never bettered.



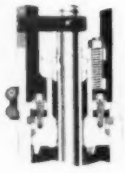
THREE-POINT GUIDING
Streamlined, cored out guide ribs, integral with body, keeps disk in alignment. Dangerous stem guiding eliminated.

SELF-CENTERING DISK THROTTLING LIP
Avoids jamming or cocking, assures tight seating, prevents wire-drawing.

*Registered trade names of Edward Valves, Inc.

FREE FLOATING TUBULAR DISK-PISTON
Quicker opening, surer closing, flow tested for less pressure loss.

EQUALIZER
Original design. Gives higher, surer piston lift, lowers pressure loss, eliminates wear-producing vibration.



EDWARD PRESSURE-SEAL DESIGN First pressure-seal non-return valves were built by Edward. Pressure-sealing parts do not guide floating disk-piston, insuring a permanent seal.

INTEX* INTEGRAL SEATS
Hard facing applied directly to valve body completely eliminates possibility of leaks behind screwed or welded-in seat rings.

These are also Edward Firsts!

Evalized* plating of valve parts for wear and corrosion resistance . . . Patented welded-bonnet Univalves* . . . Impactor* handles for small valves . . . Seat located guide ribs in gate valves . . . No-bonnet instrument valve construction . . . Intex* Stellited welded-in seats . . . Hour-glass type disk-piston . . . EValpak* packing . . . Separated feedline stop-check valves . . . Screwed and welded flanges for forged steel valves . . . Swing bolt retaining washer construction, and

Patented Interchangeability of Stop, Check and Non-Return Valves . . . **Greatest possible valve flexibility for your plant!**

Edward Non-Return Valves

DON'T SETTLE FOR LESS!

Typical Edward globe pressure-seal non-return valve design for 900 or 1500 lb, 1000 F.

No valve is more important in your boiler plant than your non-return valve.

From it, you expect quick, sure operation in an emergency. Low pressure loss is important, too.

Next time you buy non-return valves, take time to be sure. Go into design features carefully.

Also, look at actual service records.

If you do, you'll find that Edward is the most copied valve in the field. You'll find that literally dozens of features that were Edward "firsts" are now industry standards. More important, you'll find there are still many patented features still exclusive with Edward.

You'll also find that Edward has built more high-pressure high-temperature non-return valves than any other manufacturer . . . and has been building them for more years, piling up unmatched operating records.

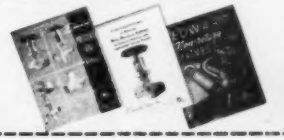
Don't discount experience. Look to Edward for the best and the first in non-return valves for pressures from 150 to 2500 lb sp.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

ASK FOR THESE CATALOGS • You should have Edward Catalogs 12-B and 12-H, covering non-return valves and pressure-seal bonnet valves in your file. Also, we'll send you a list of typical Edward non-return valve installations to show what good company you'll be keeping if you specify Edward.



Edward Valves, Inc.
1492 West 145th Street, East Chicago, Indiana

Please send me Catalogs 12-B and 12-H and the Edward non-return valve installation list.

Name .....

Street .....

City ..... Zone .... State .....

Another Rockwell Product

MORE Higher-power Gasoline FROM SAME CRUDE

. . . Now Produced by Crackers Lined with

KLEMP HEXTEEL!

Klemp Hexteel reinforces ganister linings in fractionating towers and other vessels—allows temperatures and pressures far higher than heretofore possible. Enables you to get more, higher-power gasoline from the same amount of crude! Hexteel is fixed to wall by direct weld, and lining is gunited into mesh. It's cut to your specifications to insure perfect fit, and is ready-to-install, in ¾", 1" or 1¼" by 12 or 14 gauge steel mesh. Also available in stainless steel, for processing sour crude.

KLEMP SURE FOOTED AS A CAT HEXTEEL Heavy Duty Surface Armor

Get full details on how Klemp Hexteel can help boost *your* production —write us *today!*

KLEMP HEXTEEL

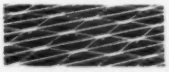
Factories in Chicago and Houston. Sales Representatives in 102 U. S. cities and 33 foreign countries.

SEE YOUR CLASSIFIED TELEPHONE DIRECTORY UNDER "GRATINGS"

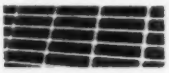
WM. F. KLEMP CO. *General Offices:* **6638 South Melvina Avenue, Chicago 38, Illinois**

KLEMP, world's largest manufacturer of open steel meshes,
ALSO MAKES THESE OTHER PRODUCTS FOR THE OIL INDUSTRY:

SERRATED STEEL GRATING


DIAMOND RIVETED GRATING

FLOORSTEEL FLEXIBLE ARMOR


WELDED STEEL GRATING

OPEN STEEL STAIR TREADS

Only A. O. Smith gives you ONE source of

UNDIVIDED RESPONSIBILITY

with SMITHway Vertical Turbine Pumps

All major pump parts of A.O.Smith Pumps are designed together, built together, to *work* together—your assurance of years of dependable, low-cost service.

When you choose an A. O. Smith Pump, you know it is *all* A. O. Smith from motor to strainer—SMITHway all the way down. You can be sure that the sum of A. O. Smith's 76 years of experience has been engineered into *every* pump part, to give you a superiority you can depend on under the toughest operating conditions.

Weight Where Weight Belongs. A. O. Smith discharge-head assemblies are built of heavy steel plate, formed and welded into the strongest, most compact design. Support for the driver and suspended assemblies is rigid, vibrationless, yet easily accessible.

Bowls are precision-machined from hard, close-grained cast iron, fitted with smooth, streamlined diffusion vanes contoured for maximum efficiency. Bronze impellers, closed or semi-open, are dynamically and hydraulically balanced.

"Tailor-Made" for Each Job. Complete interchangeability of major assemblies lets you select the right combination of driver, column pipe, lubrication, and impeller to fit each pumping application. You have an application-engineered pump exactly right for each job.

Send the coupon for complete information!

CERTAIN DISTRIBUTOR TERRITORIES for SMITHway Pumps are still available. Write for full details telling you all about the SMITHway Vertical Turbine Pump franchise. Send the coupon below for our colorful descriptive bulletin.

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To the man whose business it is to keep operating conditions up to par

Investigate the Valve Operator with THRUST Controlled Seating

The principle of the unique Thrust Controlled Seating of C-H TNY operators

During seating movement, Fulcrum is at A (above) and drive is down, toward the valve seat. At moment of tight seating, Fulcrum *transfers* to B (below) and further drive is *upward*, absorbed harmlessly by the springs.

Any movement toward progress in the Oil and Gas Industry will sooner or later bring your attention to the Cutler-Hammer TNY Valve Operator. It is the only valve operator with the principle of THRUST controlled seating . . . hence the only valve operator that can seat a valve *positively, accurately, safely, surely* . . . without necessity of manual attention or back-off . . . without danger of jammed, frozen or inoperative valves.

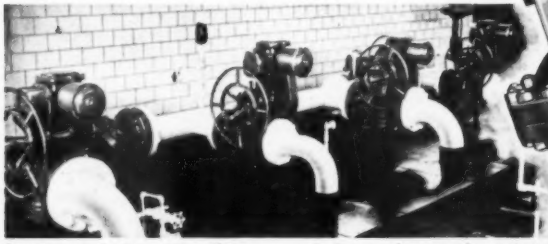
With this exclusive feature, the motor *positively* drives the valve disc home. During the driving period, the fulcrum is established at the yoke nut by heavy steel springs which exactly balance *tight seat pressure*. Therefore, at the very instant of desired tight seating, the driving fulcrum transfers to the seat of the valve, and any further drive is into the heavy springs themselves which trip the THRUST switch and harmlessly absorb motor drift.

The amazing part is that the same degree of tight seating is maintained no matter how much valve parts may expand or contract. No other valve operator has or can have this direct Thrust Controlled feature. No other valve operator can be as safe and sure and accurate. CUTLER-HAMMER, Inc., 1453 St. Paul Avenue, Milwaukee 1, Wisconsin.

For better pipe line valve performance use Experience-Engineered valve control

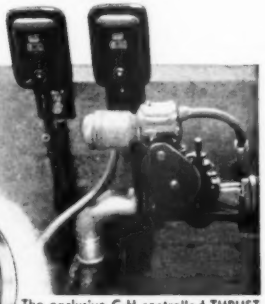
Cutler-Hammer entered the field of valve control in 1900. Its modern designs therefore reflect a "know-how" without a peer.

CUTLER-HAMMER
VALVE CONTROL
C-H



Experience-engineering makes Cutler-Hammer Valve Operators the logical first choice in the pipe line field.

At river crossings, pumping stations and terminals, C-H Operators speed operations, safeguard equipment, expedite materials flow.



The exclusive C-H controlled THRUST seating principle is successfully applied in sizes up to 80 tons *THRUST*, or down to a few lbs., as required.

in process design

these Lummus men bring you a world of experience

turn page . . .

The Lummus man

responsible for the process design of your project has had more than fifteen years' experience in design, development and operation. He holds a master's degree in Chemical Engineering from a leading university or engineering college. His background includes refinery operation, maintenance and construction along with process design engineering.

Noteworthy projects that have widened his Lummus' experience are: the 2 world's largest synthetic rubber projects; the 13 complete aviation gasoline plants; over 60 solvent refining lube oil plants, and the many thermal cracking, polyforming and coking units.

His background is worldwide. Currently, he is at work in England, Egypt, France, Sweden, Venezuela, and across the United States. He serves on technical committees, lectures on refinery and chemical engineering practice, and writes technical papers. His viewpoint is broad and practical.

The Lummus Process Design Engineer—trained to work with molecules—is equally well equipped to work with people. You will find him keenly aware of the gains that come from co-operative interchange of information with your own technical staff. He contributes in large degree to the satisfactory relations that exist between industry and Lummus.

THE LUMMUS COMPANY
420 Lexington Avenue, New York 17, N. Y.

LUMMUS

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Société Française des Techniques Lummus
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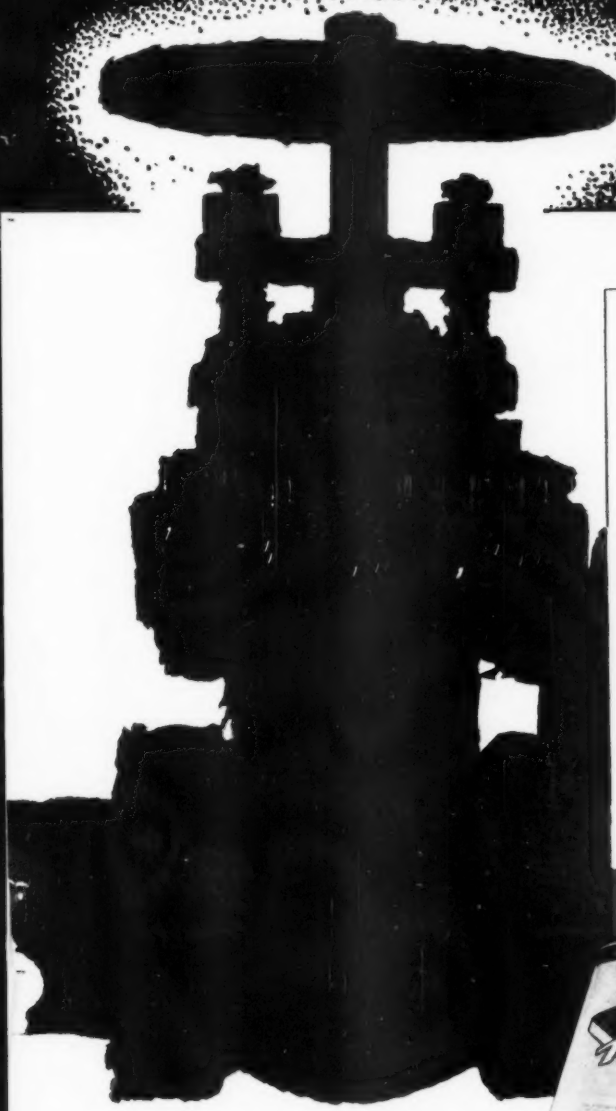
PROTECT or PAY

You have no other choice!



Corrosion costs industry over $6,000,000,000 annually. No business escapes its effects. Attacks by acids, alkalis, salts, gases and atmospheric conditions cause untold damage that often is overlooked until too late.

Don't risk needless waste. Most conventional coatings fail when corrosion threatens. That's why Amercoat is designed to give *extra protection* against surface failure. Highly resistant to a wide variety of chemicals, brines, fumes, weathering and abrasion, it is available in a number of formulas, *each designed to meet specific conditions.*

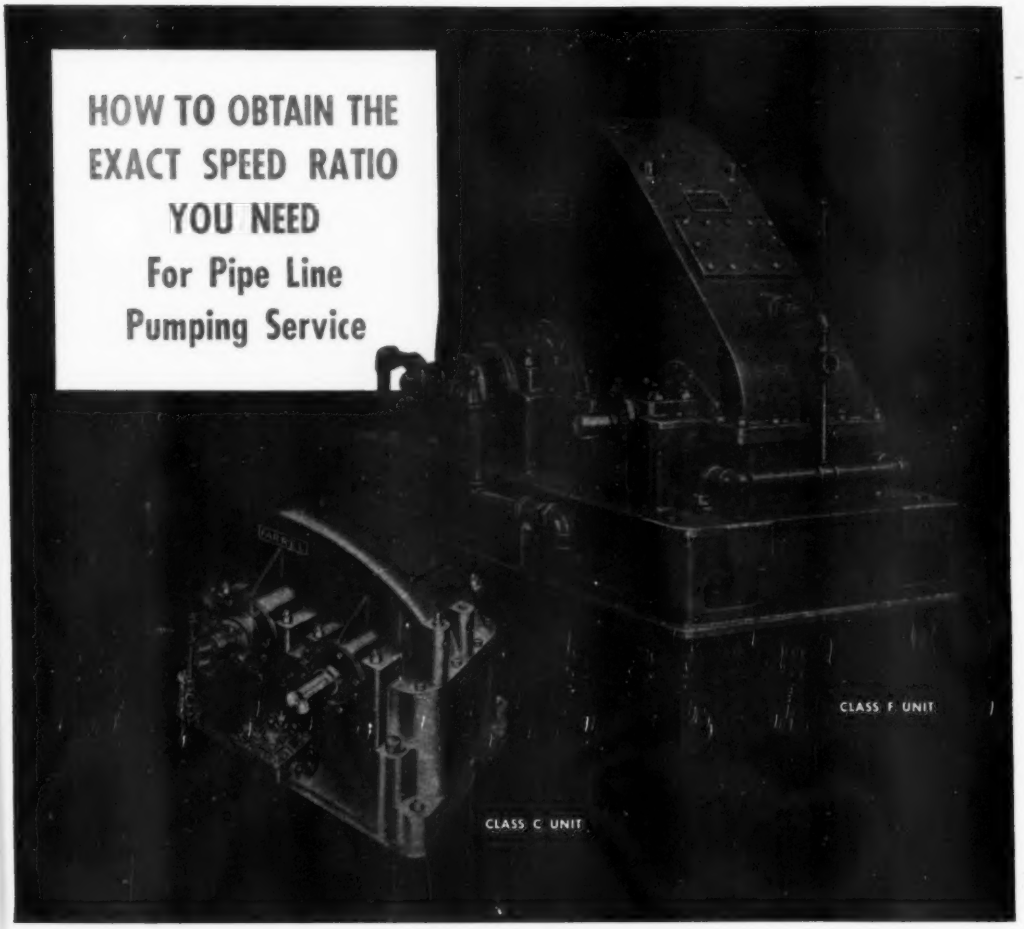
Corrosion ruined this valve. Amercoat protection would have multiplied its useful life many times over. Be sure your plant and equipment are safe from corrosion damage. Protect with Amercoat.

AMERCOAT CORPORATION
A Division of
AMERICAN PIPE AND CONSTRUCTION CO.
4809 Firestone Blvd., South Gate, Calif.

Check danger points like this in your plant —
Piping • Machinery
Walls and Ceilings
Fixtures • Tanks
Floors • Conveyors
Laboratory Equipment
...and all other areas exposed to agents of corrosion or contamination.

FOLLOW THE LINE OF *most* RESISTANCE

HOW TO OBTAIN THE EXACT SPEED RATIO YOU NEED For Pipe Line Pumping Service



From the Farrel® line of geared speed increasers you can obtain the exact ratio you require for stepping up engine or motor RPM to the desired pump speed. 49 standard sizes provide speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

Farrel speed increasers were the first to be developed in a standard series for pipe line pumping service. That was eighteen years ago, and the original units, as well as all of those installed since, are still in operation, performing as well as on the day they were put into service.

For full information about these time-proved speed increasers, write for your copy of Bulletin No. 448. No cost, no obligation.

FARREL-BIRMINGHAM COMPANY, INC., 344 VULCAN STREET, BUFFALO 7, N.Y.

Plants: Ansonia and Derby, Conn., Buffalo, N.Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Detroit, Chicago, Los Angeles

OIL FIELD REPRESENTATIVES: Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 822-A M & M Building, Houston 2, Texas

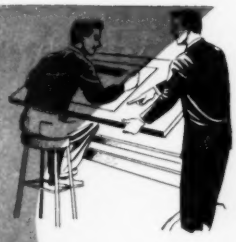
Farrel-Birmingham

FB-566

TESCO

TEXAS' MOST MODERN FOUNDRY PROVIDES ALL THESE FACILITIES TO MAKE YOUR CASTINGS DEPENDABLE

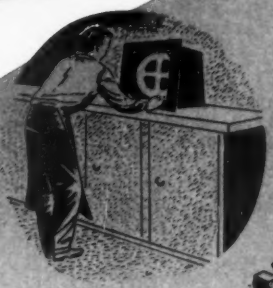
Tesco provides a product engineering department to work with manufacturers while products are still in the design stage to insure the strongest, most economical casting designs.

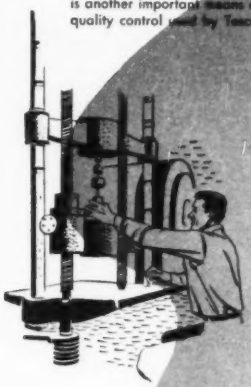


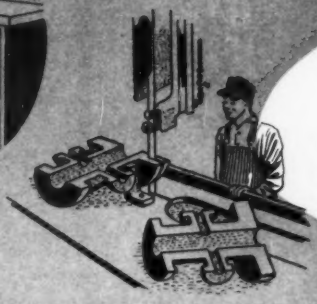
From every heat of steel, Tesco chemists take a ladle sample for exhaustive physical and chemical analysis.

In Tesco's chemical laboratory . . . the finest science can offer . . . specifications are maintained through strict laboratory control.

Radiographic examination is another important means of quality control used by Tesco.







By destructive laboratory examination, Tesco metallurgists keep a close check on the internal structure of the steel.

Tensile tests are made to determine strength and ductility of the steel in every heat.

Grain structure of Tesco steel is microscopically examined and photographed, to prove thoroughness of heat treatment.

Samples also undergo the impact test to determine strength, ductility and resistance to shock or impact.

At Tesco there is every modern facility in tools and craftsmanship to produce the very highest quality Steel Castings for every industrial need. The exhaustive physical and chemical tests illustrated here, for example, constitute a sort of "birth certificate" for every heat of steel. From such tests metallurgists can make sure that the steel meets all the exact requirements. These records are carefully preserved for future reference. Thus, every steel casting produced in Tesco's foundry results from a backlog of experience. Let us show you how Tesco Steel Castings can help you produce stronger, better appearing products at less cost.

Before you design a new product or redesign an old one, let the Tesco equipment engineer help you reduce costs and get into production sooner.

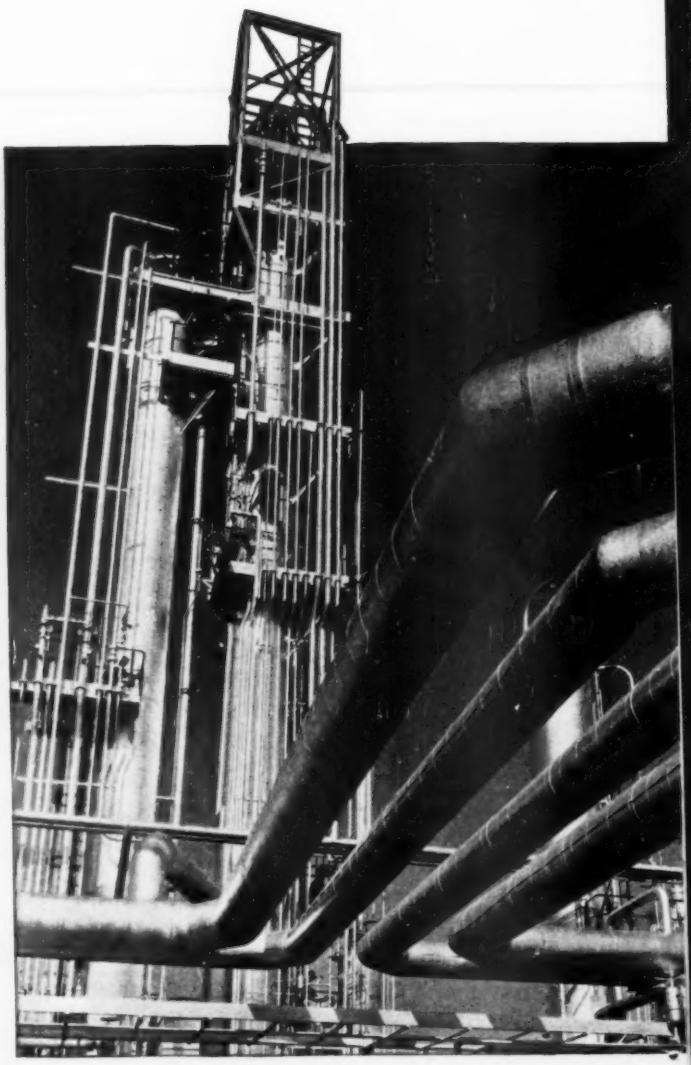
TESCO

TEXAS ELECTRIC STEEL CASTING CO.

TESCO IS THE MOST EXPERIENCED FOUNDRY ON THE GULF COAST.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



Turbines

Turbo Generators

Ignitron Rectifiers

A. C. Motors

Gear Motors

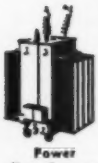
Speed Reducers

Corrosion Resisting Motor Control

Circuit Breakers for Hazardous Locations

Disconnecting Switches

Instruments



Power Transformers

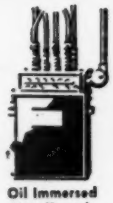
Distribution Transformers and Switchgear

Capacitors

Industrial Lighting

Electronic Tubes

Oil Immersed Pushbuttons



Oil Immersed Panelboards

WESTINGHOUSE

Westinghouse

EQUIPMENT FOR THE PETROLEUM INDUSTRY

Unit Responsibility

CUTS REFINERY POWER COSTS

The manufacturer of your power generating and distribution equipment can play a vital role in providing the most efficient power system for your refining and petrochemical processes. In serving you, that manufacturer should be capable of:

1. Providing the complete line of power equipment your process may require.
2. Furnishing you co-ordinated engineering and supervision of installation.
3. Giving you the benefit of years of experience in the application of power equipment in the Petroleum Industry.

These elements of unit responsibility add up to a reduction in costs. You get them all from Westinghouse.

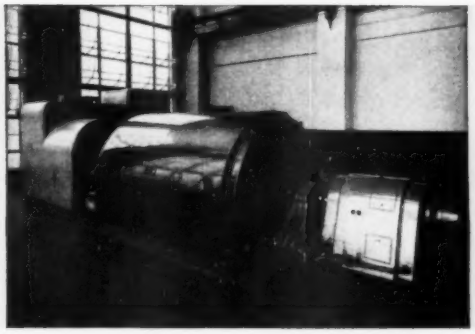
GENERATION: Westinghouse gives you the complete installation for producing power, plus help in working out your electrical and steam requirements for most efficient plant balance.

DISTRIBUTION: Westinghouse makes a correlated line of distribution apparatus, ranging from the smallest arrester to the world's largest substation. All indoor and outdoor enclosures are Bonderized to resist corrosion, and outdoor switchgear is additionally protected by all-weather undersurface coating.

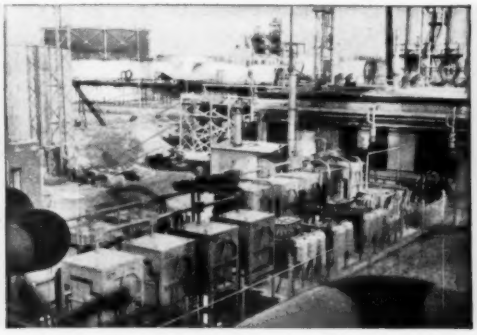
UTILIZATION: Westinghouse makes a full line of mechanical drive turbines and oil refinery motors, ranging from small, explosion-proof, fan-cooled, Life-Line motors to the largest explosion-resisting, inert-gas-filled, squirrel-cage type motors ever built. A complete line of Westinghouse controls, including corrosion-proof or explosion-proof types where needed, is also available to meet the rigid requirements of refinery service.

Give us an opportunity to assume this unit responsibility and help you find the solution to your refinery power problems. Call your nearest Westinghouse office, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

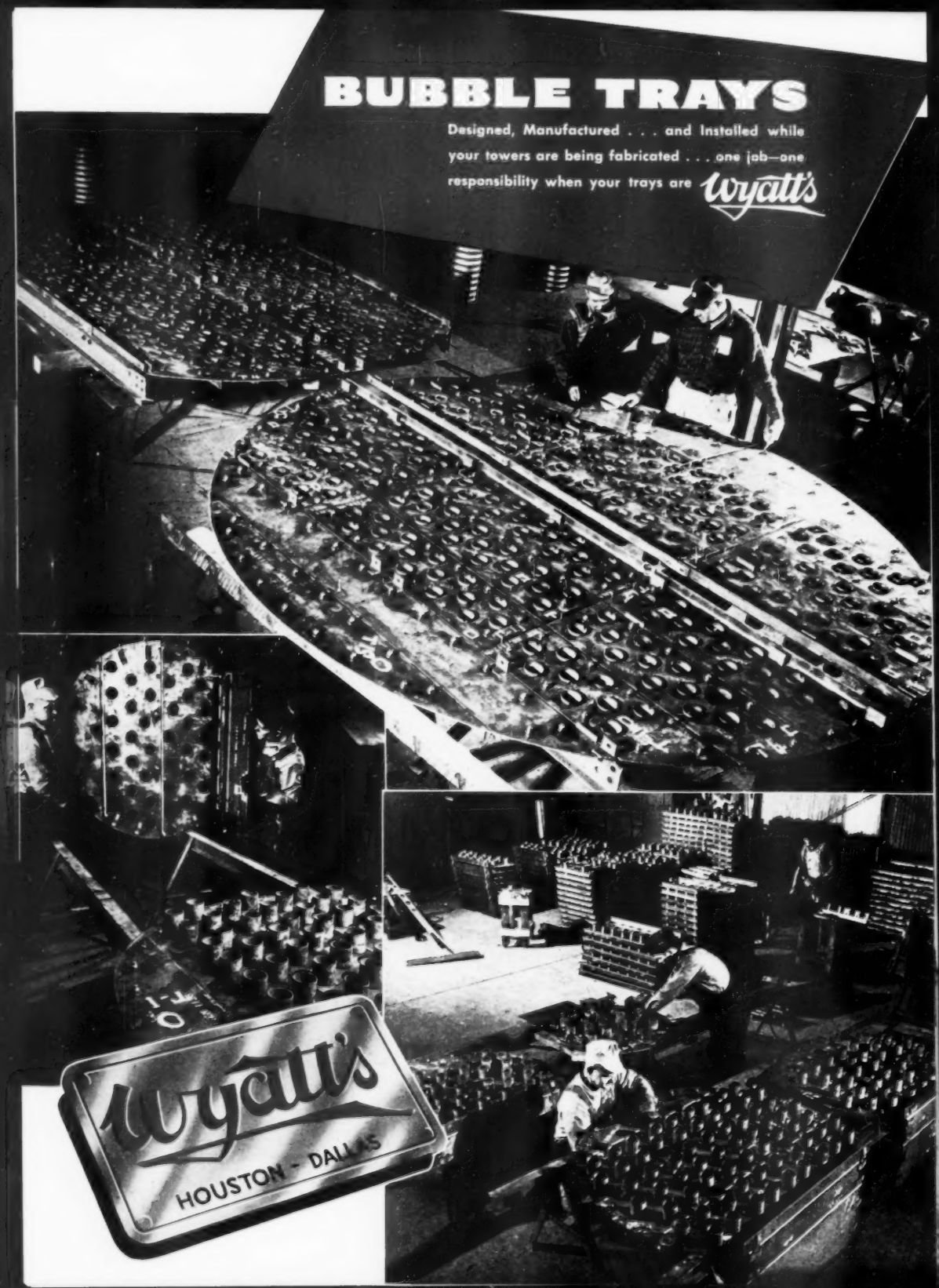
J-94803



This Westinghouse 7500-kva turbogenerator is installed in a large refinery power plant. Where utility power is not available in sufficient quantities for a large refinery, units of this type provide an economical source of power.



The use of Westinghouse oil-immersed equipment suitable for hazardous and corrosive atmospheres, made it possible to locate this motor control and distribution center near the loads, thus reducing length of individual circuit runs.

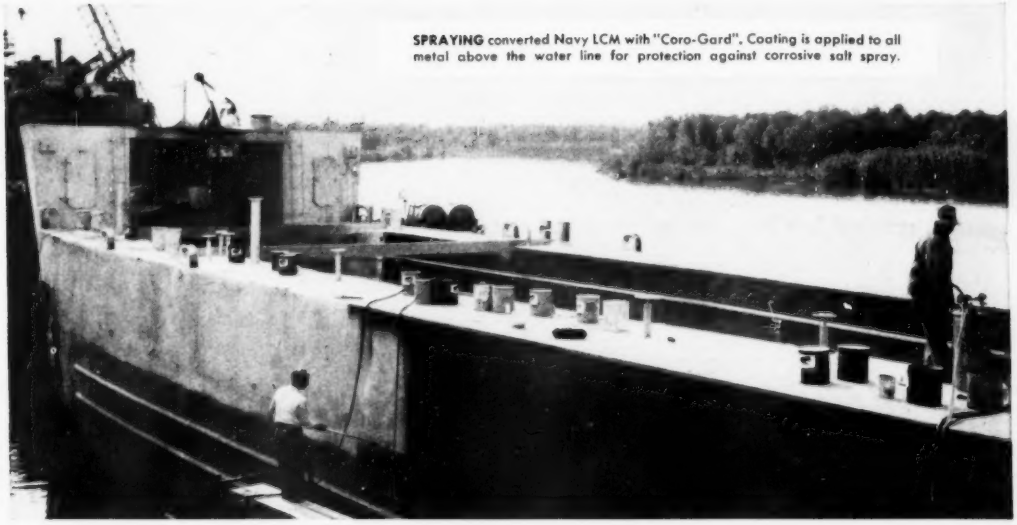

BUBBLE TRAYS
Designed, Manufactured . . . and Installed while your towers are being fabricated . . . one job—one responsibility when your trays are Wyatt's
Wyatt's
HOUSTON - DALLAS

Lasting protection for off-shore drill equipment

Drill rigs and boats coated with "Coro-Gard" for longer life in corrosive salt waters

Now "Coro-Gard" protects drill rigs seven miles at sea—and their supply boats! Salt spray, immersion, high humidity, crude oil, rain squalls, and scorching sun have no effect on this tough anti-corrosive coating. Actual operating tests by a Gulf Coast oil company prove that "Coro-Gard" cuts expensive maintenance costs, requires less re-coating, gives long protection.

Whatever your corrosion problem, there's a "Coro-Gard" Coating System to save *you* time and money. Our engineers have prepared coating systems to satisfy every need. Write today for complete information.



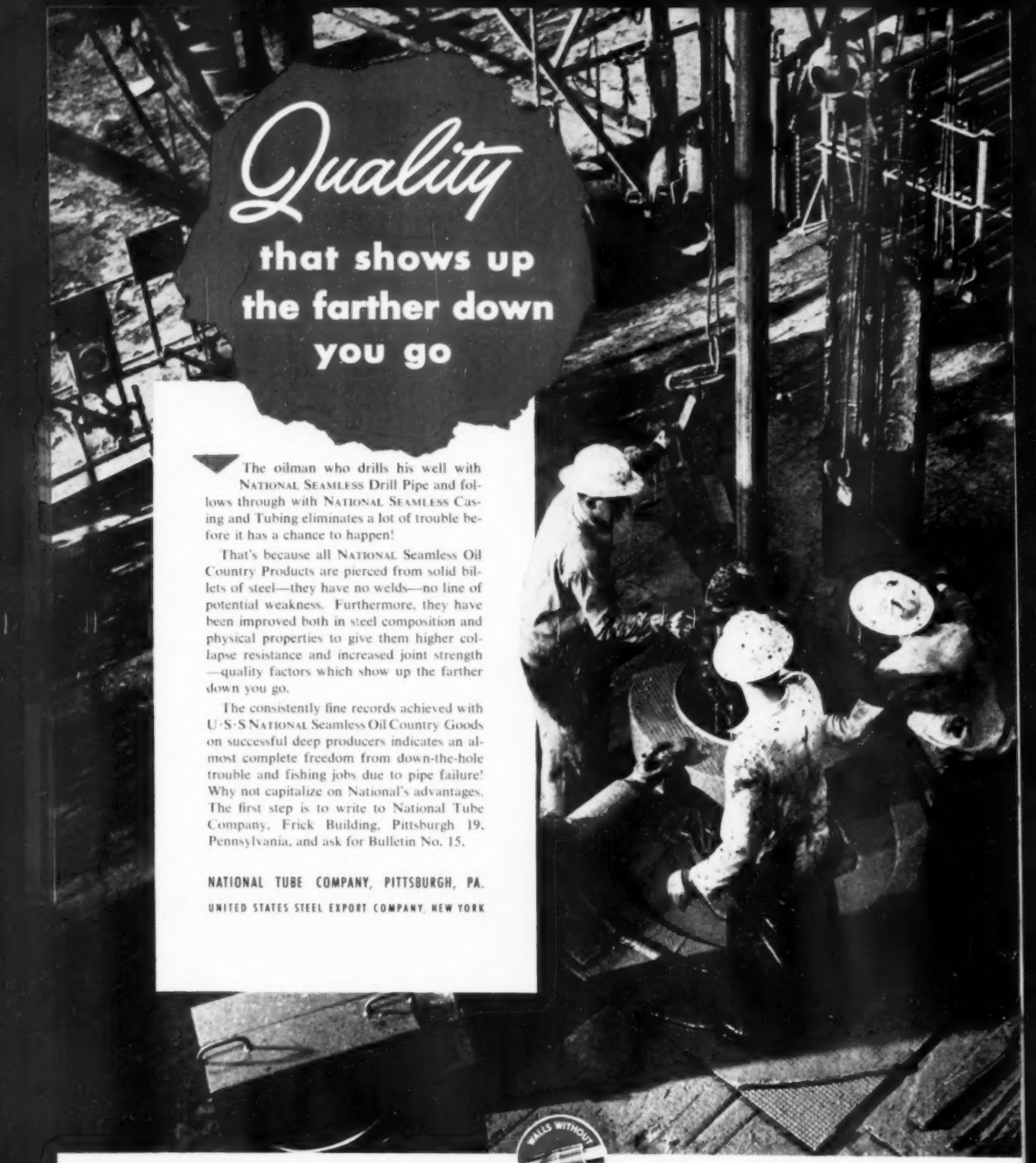
SPRAYING converted Navy LCM with "Coro-Gard". Coating is applied to all metal above the water line for protection against corrosive salt spray.

See us at the convention!

We'll be at the N.A.C.E. convention in St. Louis, Mo., from April 4th through April 7th. Stop at booth #76 in the Hotel Jefferson. We'll be glad to give you the latest information on "Coro-Gard" Coating Systems. You'll see for yourself how "Coro-Gard" saves!

Made in U.S.A. by MINNESOTA MINING & MFG. CO., ADHESIVES AND COATINGS DIVISION, 411 Piquette Avenue, Detroit 2, Michigan
Also makers in St. Paul 6, Minn., of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Abrasives.

General Export: DUREX ABRASIVES CORP., *New Rochelle, N. Y.* • *In Canada:* CANADIAN DUREX ABRASIVES, LTD., *Brantford, Ontario*



Quality

that shows up the farther down you go

The oilman who drills his well with NATIONAL SEAMLESS Drill Pipe and follows through with NATIONAL SEAMLESS Casing and Tubing eliminates a lot of trouble before it has a chance to happen!

That's because all NATIONAL Seamless Oil Country Products are pierced from solid billets of steel—they have no welds—no line of potential weakness. Furthermore, they have been improved both in steel composition and physical properties to give them higher collapse resistance and increased joint strength —quality factors which show up the farther down you go.

The consistently fine records achieved with U·S·S NATIONAL Seamless Oil Country Goods on successful deep producers indicates an almost complete freedom from down-the-hole trouble and fishing jobs due to pipe failure! Why not capitalize on National's advantages. The first step is to write to National Tube Company, Frick Building, Pittsburgh 19, Pennsylvania, and ask for Bulletin No. 15.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

WALLS WITHOUT WELDS

USS

NATIONAL SEAMLESS

drill pipe...casing...tubing

UNITED STATES STEEL

Headquarters Insignia . . .

. . . for Refiner's No. 2 Operating Material

Today, petroleum refiners use about 1,000 different chemicals in their routine operations, many of them in large volumes. Away up in *number two slot* on this formidable list is *sorptive minerals*—to the tune of some 200,000 tons per year. Adsorbents, as vital processing chemicals, are second only to sulfuric acid.

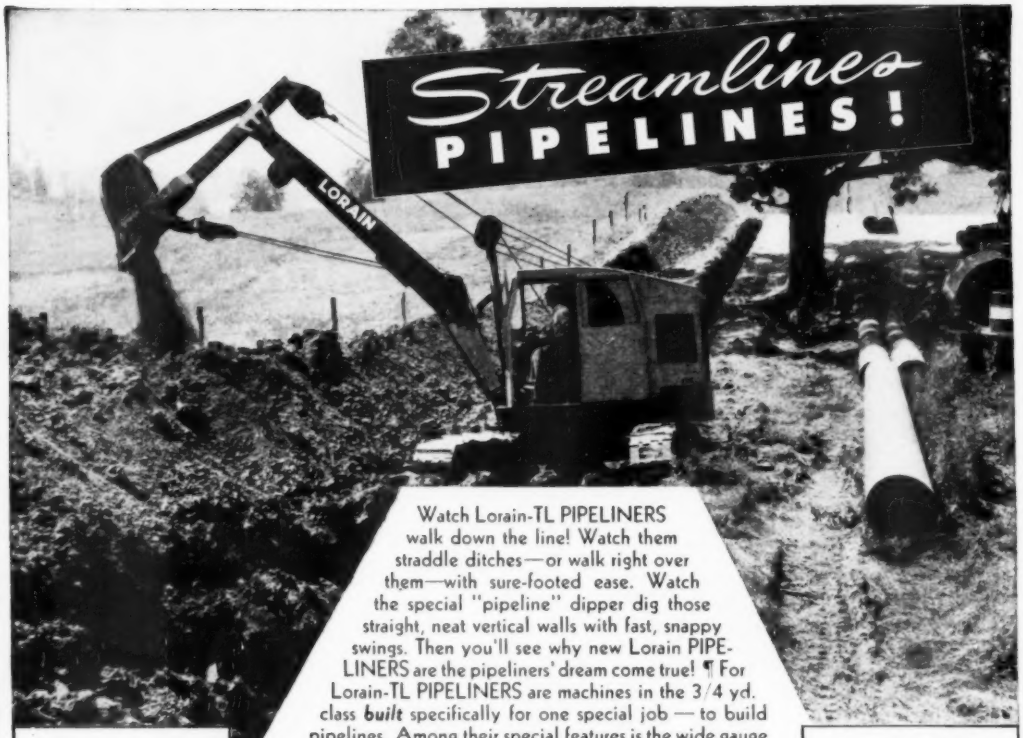
It is all the more significant, then, that Attapulgus Fullers Earths and Porocel Activated Bauxites have become recognized standards in the field of adsorbents. As of now, at least a billion barrels of petroleum cuts—from the lightest distillates to the heaviest lube and wax fractions—have been treated by Attapulgus or Porocel materials to gain remarkable finished value.

This all adds up to a lot of specialized experience—intimate acquaintance with the process techniques for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from hydrocarbons, as well as for systems employing solid catalysts. And, of equal importance, laboratory and plant experience with the many treatments which precede the application of our two basic materials to specific adsorbent jobs.

Perhaps our broad knowledge can be of real help to you in selecting the right adsorbent and the right conditions. Our staff is at your service, without obligation.

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. V, 210 West Washington Square, Philadelphia 5, Pa.



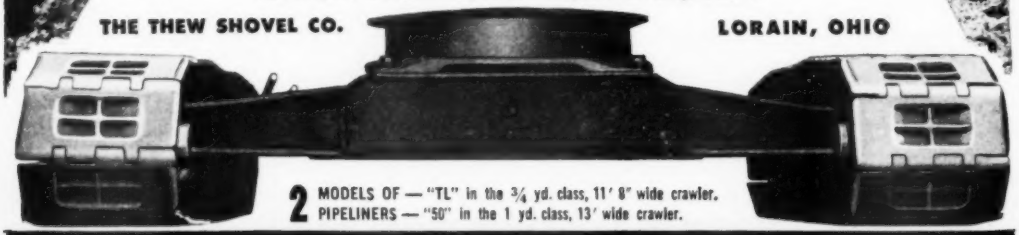
Watch Lorain-TL PIPELINERS walk down the line! Watch them straddle ditches—or walk right over them—with sure-footed ease. Watch the special "pipeline" dipper dig those straight, neat vertical walls with fast, snappy swings. Then you'll see why new Lorain PIPELINERS are the pipeliners' dream come true! ¶ For Lorain-TL PIPELINERS are machines in the 3/4 yd. class ***built*** specifically for one special job — to build pipelines. Among their special features is the wide gauge crawler, 11 ft. 8 inches wide, which spans the ditch with plenty of clearance so that cave-ins are prevented. ¶ This is but one of the many reasons pipeline men are putting ***more*** and ***more*** and ***more*** Lorain-TL PIPELINERS on their jobs. The Lorain "TL" design holds a lot more in store, too. It's the latest, newest machine . . . with ***exclusive*** features such as interchangeable "packaged" components consisting of major assemblies which are individually removable and interchangeable; a one-piece, all-welded, all-steel turntable bed with hook rollers; oil enclosed gears; anti-friction bearings . . . plus many more that keep PIPELINERS working longer and steadier. ¶ Here's the PIPELINER . . . for pipeline men only . . . to streamline your jobs for profit! Investigate now!

Illustrated above is a Lorain-TL Pipeliner of Williams Bros. internationally famous pipeline builders. Williams Bros. also use Lorain-50 Pipeliners (in the 1 yd. class) mounted on crawlers 13 ft. wide.

NOW SHOWING
New "Pipeliner" Movie

For Pipeline Men Only! Shows Lorain PIPELINERS at work . . . proof of performance on actual jobs. Ask your Thew-Lorain Distributor for a show!

THE THEW SHOVEL CO. **LORAIN, OHIO**

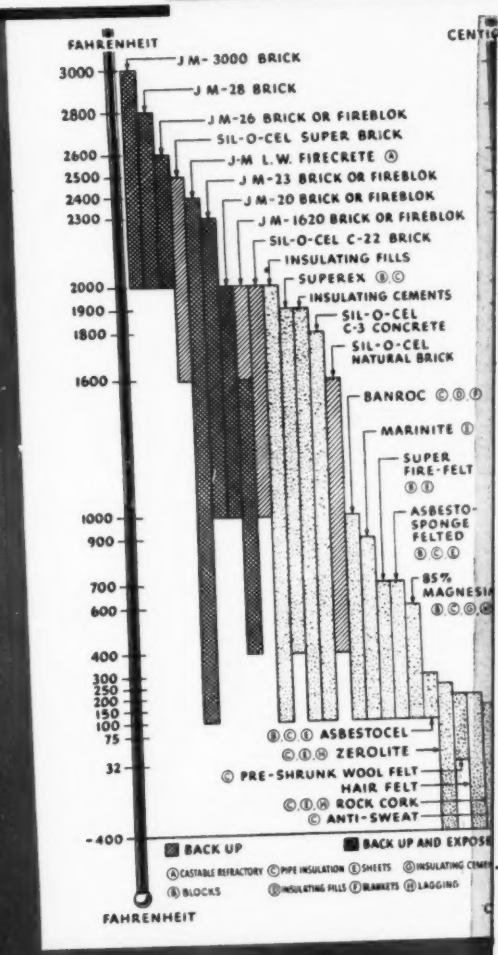


2 MODELS OF — "TL" in the 3/4 yd. class, 11' 8" wide crawler.
PIPELINERS — "50" in the 1 yd. class, 13' wide crawler.

THEW ® LORAIN PIPELINER

Ready reference chart...

Johns-Manville THERMAL INSULATIONS



FOR EVERY TEMPERATURE JM EVERY

Yours... for better insulation service!

Now, you can see at a glance the recommended insulation for every temperature range, from minus 400F to plus 3000F.

It's all on this convenient Johns-Manville Thermal Insulation Chart (11½" x 18") available for hanging in your office or on your plant wall.

Each insulation in this group of Johns-Manville products is tailor-made to do a specific type of job *best.* And, as part of the Johns-Manville Insulation Service, specialists are available to help you with present insulation problems . . . or with those connected with future plans.

By having these men select and apply Johns-Manville insulations, you will be dealing with men who have grown up in the business. You'll find that it will pay, in the long run, to have these experts help you... *because they have to their credit more man-hours of insulation application experience than all other similar types of organizations combined.*

For your copy of this chart, just fill in and mail the coupon below.

Johns-Manville
Box 290
New York 16, N. Y.

Please send me copy of Johns-Manville Insulation Chart IN-6D.

Name_____

Title_____

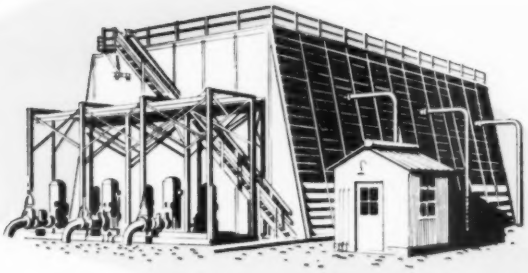
Company_____

Address_____

City_____ State_____

IG-3

For day in, day out *dependability*—you can't beat a



BJ VERTICAL COOLING TOWER PUMP

FOR REFINERY OPERATION — these pumps have what it takes to handle 'round-the-clock, seven-days-a-week, 52-weeks-per-year pumping! Because they are *BJ engineered*, you can be sure they'll measure up to your cooling tower requirements. Because they are *BJ built*, you can be sure of steady-going, low cost operation that won't let you down.

These are some of the features that make BJ Vertical Cooling Tower Pumps dependable performers: *Rigid alignment*—all parts are machined with shoulders and recesses to form metal to metal joints. *Self-priming*—the self-contained pumping unit takes suction from the pit in which it is mounted. *Simple installation*—vertical suspension saves space and cuts installation cost. *Saves piping*—pump element is suspended on a welded steel discharge column with the motor mounted at the top of the column and direct coupled to the driver shaft. Capacities to 7500 gpm and heads as required. Furnished with motor or to fit motor you have.

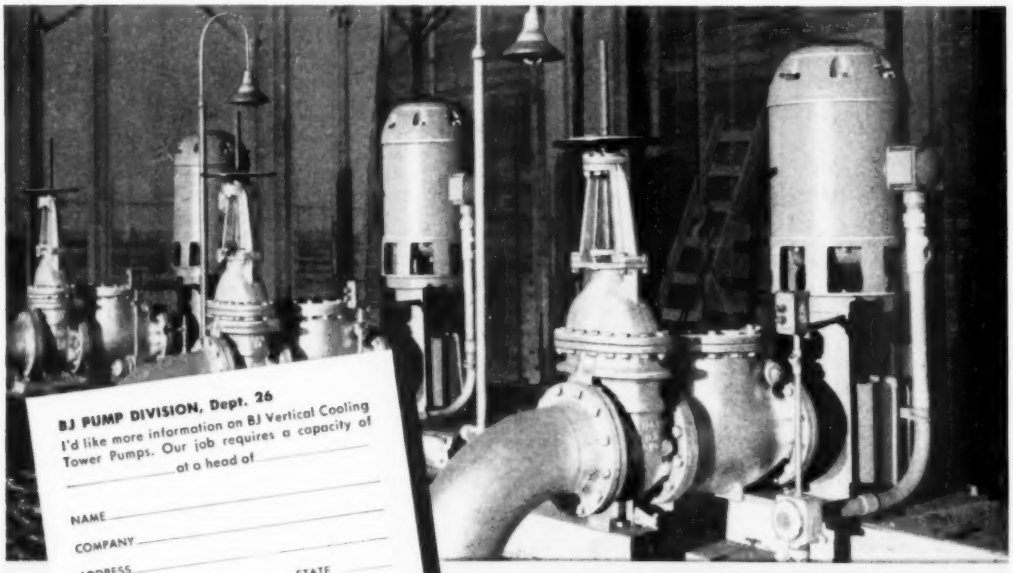
Ask your local BJ representative or send the coupon below for details.

Byron Jackson Co.

Since 1872

P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

OFFICES IN PRINCIPAL CITIES



BJ PUMP DIVISION, Dept. 26
I'd like more information on BJ Vertical Cooling Tower Pumps. Our job requires a capacity of _____ at a head of _____

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

BJ VERTICAL COOLING TOWER PUMPS INSTALLED AT GULF OIL CORP., GYPSY DIVISION, EUNICE, NEW MEXICO

For highest uniformity of catalyst characteristics--

DAVISON FLUID SYNTHETIC CRACKING CATALYST....

More and more leading refineries are standardizing on Davison DA-1 as the synthetic cracking catalyst known to them to give the maximum efficiency and economy in operation. DA-1 is available as . . . F-1, FINE GRIND; C-1, INTERMEDIATE GRIND; C-2, COARSE GRIND . . . all produced under close laboratory control to maintain the high standard of uniformity in physical, chemical and catalytic characteristics . . . your assurance of maximum catalyst utilization.

For special processes, Davison can place at your service an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granulated, powdered or pelleted form.

WRITE FOR INFORMATION AND SPECIFICATIONS

...In addition Davison offers you

FACILITIES—Plants located in Baltimore and Cincinnati assure you of fast service from established sources.

EXPERIENCE—You receive the benefits of our experience as the oldest producer of fluid synthetic cracking catalysts.

SERVICE—Davison service includes new and expanded facilities for catalyst evaluation and trouble-shooting.

THE DAVISON CHEMICAL CORPORATION

Progress through Chemistry

BALTIMORE-3, MD.

How do these pieces fit together in your forging picture?

CHANCES are good that your particular cost-quality puzzle can be solved with Timken® forging bars. Uniformity is the key.

Finished products made from Timken forging bars have uniformly high quality because you start with uniformly high quality stock. Superior surface and internal quality is a feature of every bar.

And costs are lowered through fewer delays, fewer rejects and fewer changes in shop practices—results of Timken forging bars' uniform forgeability, uniform response to heat treatment and uniform physical and chemical properties.

This uniformity is maintained by The Timken Roller Bearing Company's close, complete quality control. Every step of manufacture is under the Timken Company's roof. And special mill practices, advanced research, special inspection techniques and years of experience all help keep the quality of Timken fine alloy forging steels the best.

For qualified help with your forging problems, write us today. Ask, too, for our authoritative, 112-page booklet, "Evaluating the Forgeability of Steels". The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing

One Way to Obtain a Price "Edge" for Your Products

...Eliminate this High Cost!

Industrial Eye Accident Costs UP 78½%* SINCE 1939

The high costs of eye accidents (apparent and hidden) increase the selling price of what you make and lower your profits. Today, when markets are competitive and "break even" points are high, management has found that the installation of an AO eye protection program represents a *definite* and *important* step in reducing accident costs.

"Definite", because AO records show that there is nothing conjectural about the savings . . . "important" because the savings are *large* — as high as five figures annually in some cases. Ask your AO Safety Representative for complete details.

FACTS TO REMEMBER—
Average eye accidents cost industry over $5 per employed worker per year . . . cost over $328 per injured worker in compensation . . . are 98% preventable by goggles costing approximately $2.30.

American Optical Company
SAFETY PRODUCTS DIVISION

Southbridge, Massachusetts • Branches in Principal Cities

Most Powerful Chevrolet Trucks Ever Built!

Plenty of power—and dependable power—to handle heavy loads at lowest cost! Two great engines bring you new power, new stamina, new and spectacular performance with economy. These 1950 Chevrolet P•L trucks are the most powerful trucks Chevrolet has ever built.

In performance, popularity, payload and price, Chevrolet is the outstanding leader! Chevrolet is the nation's choice for every trucking job . . . and on each job, these P•L trucks have established their right to leadership by years of outstanding service.

CHEVROLET MOTOR DIVISION, *General Motors Corporation*
DETROIT 2, MICHIGAN

Far ahead with all these PLus *Features:*

• TWO GREAT VALVE-IN-HEAD ENGINES: the New 105-h.p. Load-Master and the improved 92-h.p. Thrift-Master—to give you greater power per gallon, lower cost per load • THE NEW POWER-JET CARBURETOR: smoother, quicker acceleration response • DIAPHRAGM SPRING CLUTCH for easy action engagement • SYNCHRO-MESH TRANSMISSION for fast, smooth shifting • HYPOID REAR AXLES—5 times more durable than spiral bevel type • DOUBLE-ARTICULATED BRAKES—for complete driver control • WIDE-BASE WHEELS for increased tire mileage • ADVANCE-DESIGN STYLING with the "Cab that Breathes" • BALL-TYPE STEERING for easier handling • UNIT-DESIGN BODIES—precision built.

CHEVROLET
P*•L*
ADVANCE-DESIGN TRUCKS

P*opularity L*eaders

The public's overwhelming preference for Chevrolet is proof of owner satisfaction earned through the years. Beyond question, Chevrolet P•L trucks are the nation's leading choice in the entire truck field.

P*erformance L*eaders

The new Chevrolet P•L trucks give you high pulling power over a wide range of usable road speeds—and on the straightaway, high acceleration to cut down total trip time.

P*ayload L*eaders

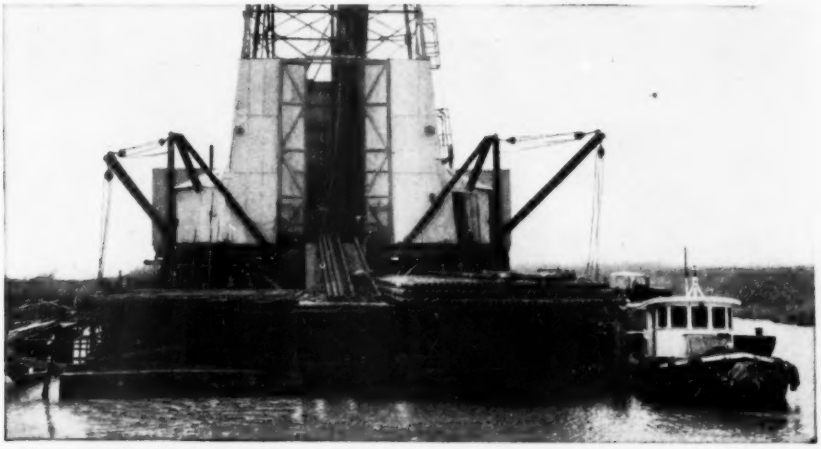
The rugged construction and all-around economy of Chevrolet P•L trucks cut operating and repair costs—let you deliver the goods with real reductions in cost per ton per mile.

P*rice L*eaders

From low selling price to high resale value, you're money ahead with Chevrolet trucks. Chevrolet's rock-bottom initial cost—outstandingly low cost of operation and upkeep—and high trade-in value—all add up to the lowest price for you.

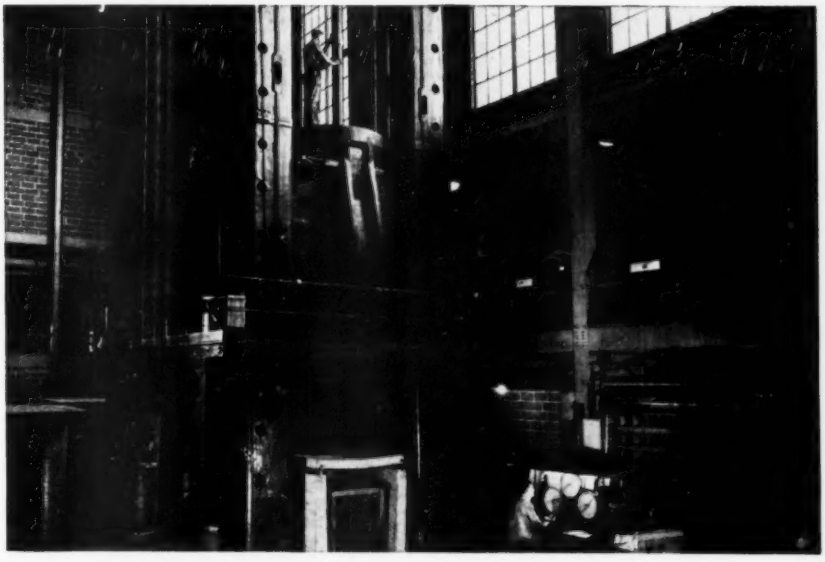
CHEVROLET

DEPENDABILITY THROUGH



IN A SOUTHERN FIELD: A 10,000-foot string of 7-inch A.O. Smith Casing being run in the bayous of Louisiana.

RESEARCH AND ENGINEERING



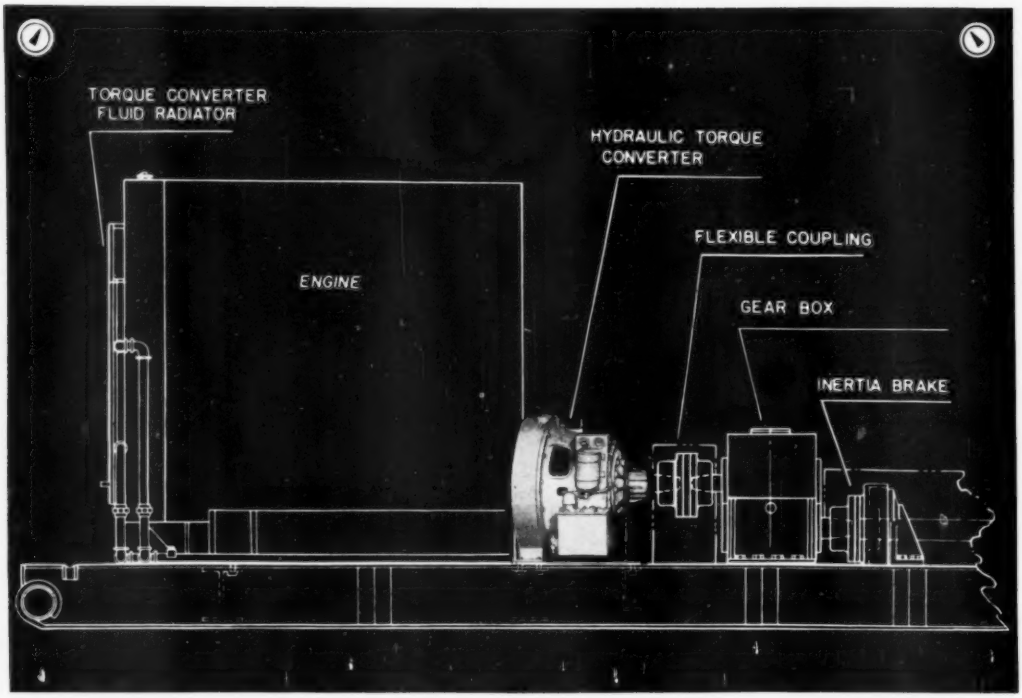
IN THE LABORATORY: Pull-out characteristics of A.O. Smith Casing are constantly tested.

A.O. Smith 76th Anniversary 1874 1950

A.O.Smith
CORPORATION

CASING • LINE PIPE

New York 17 • Boston 16 • Washington 6, D. C.
Atlanta 3 • Pittsburgh 19 • Chicago 4 • Houston 2 • Dallas 1 • Seattle 1 • Los Angeles 14
Tulsa 3 • International Division: Milwaukee 1



PUT THIS CONVERTER IN *YOUR* DESIGN

From among Twin Disc's three series of Hydraulic Torque Converters . . . more than 44 different models . . . there's one that you can put right into your design.

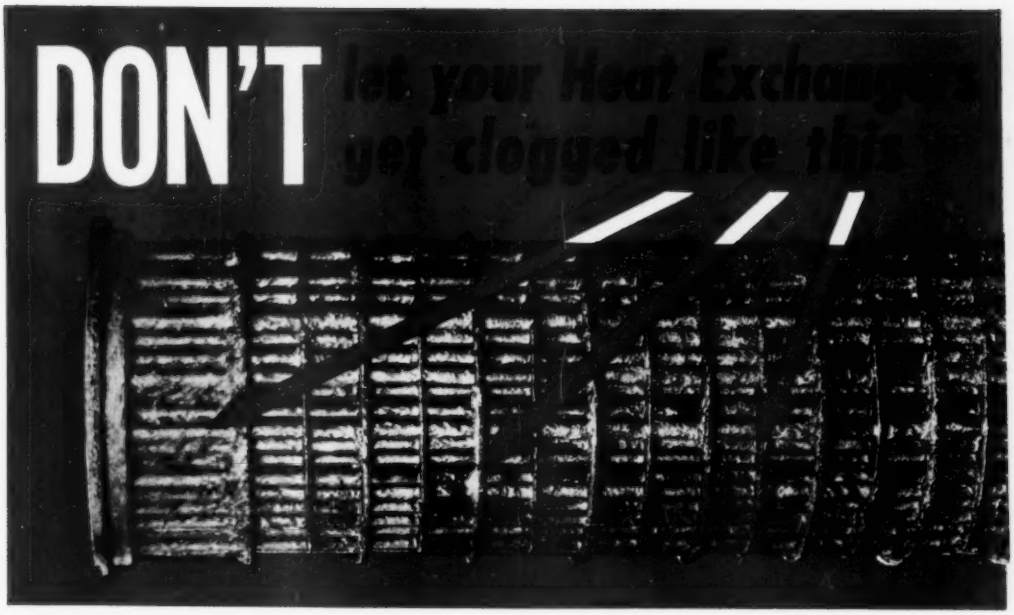
Whether it's an independent rotary drive like the sketch shown above, or a heavy-duty drilling rig involving multiple engines, you'll find Twin Disc's Hydraulic Torque Converters (Lysholm-Smith type) offer the greatest overall torque multiplication . . . extend the capacity of your rig by transmitting up to five times engine torque when that torque is needed.

Capable of transmitting from 40 to 1000 hp, Twin Disc's Hydraulic Torque Converters are standard equipment on many designs of production hoists, clean out rigs, heavy-duty drilling rigs, independent rotary table drive units, and pump drives. Why not investigate now? Write the Hydraulic Division for your copy of Engineering Bulletin 135-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

TWIN DISC
Converters can be:

- Mounted directly onto the hoist compound and driven through intermediate jackshafts.
- Independently mounted in front of hoist transmission.
- Direct-connected to engines placed at right angles to drum shaft.
- Mounted at right angles to a truck engine with right angle power take-off.

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918



With Oakite chemical cleaning your maintenance staff can now handle this job easily at LOW COST!

When carbonized oil, sludge, wax, lime-scale, rust, slime and other deposits have completely CLOGGED your shell and tube type equipment you are immediately confronted with a tough, time-consuming, expensive cleaning job to restore heat transfer.

Scheduled Cleaning Saves Time and Money

But there is an easy way you can avoid this situation. DON'T POSTPONE OR DEFER CLEANING TOO LONG! Instead, clean your heat exchange equipment on a regular periodic basis. Doing this saves time, cuts cleaning cost. Three effective Oakite cleaning methods are available to you for this important and continuing maintenance work: (1) Circulating method; (2) Tank method; (3) Steam cleaning method. Take advantage of specialized Oakite materials and long years of Oakite experience in helping other refineries set up this maintenance work on a planned schedule of cleaning because heat exchangers can then be cleaned FASTER, deposits removed EASIER and down-time considerably SHORTENED.

Oakite Technical Service Is Nationwide

Since Oakite Technical Service involves no cost or obligation write today and ask us to send you our free Booklet describing heat exchanger cleaning and outlining many other applications of specialized Oakite materials in the petroleum industry.

OAKITE PRODUCTS, INC., 50B Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE
REG. U. S. PAT. OFF.
Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

Free

This 32-page Booklet based on the successful use of Oakite materials and methods in the producing, refining, and marketing divisions, describes many different maintenance cleaning jobs. Write for your free copy today.

extra service for your equipment when

"WEAR-RESISTED"

with AIRCO hardfacing alloys

Because of the hardness and other desirable characteri-tics of these alloys, they provide high resistance to all types of wear – abrasion . . . impact . . . heat . . . corrosion. One application often adds 2 to 25 times longer service life to *worn or new* parts . . . big dividends in savings of "down-time" and replacements.

There is an Airco alloy available for oxyacetylene flame or electric arc application to meet all types of wear conditions.

1. *Severe abrasion and medium impact*
2. *Shattering impact and abrasion*
3. *Severe impact and abrasion*
4. *Sliding abrasion and impact*
5. *Extreme earth abrasion*
6. *Corrosion and heat*

Constant research is developing new alloys to meet special wear problems as they occur.

If you have parts or tools subject to any type of wear, it will pay you to investigate the savings you can make in maintenance and replacement costs by using Airco Hardfacing Alloys.

For further information about Airco's complete line of "wear-resistant" alloys, write your nearest Airco office or Authorized Dealer for a free copy of the Hardfacing Alloys Catalog.

More news about AIRCO products

FOR SEVERE IMPACT AND RESISTANCE TO ABRASION
Airco No. 388 Electrode

A shielded arc electrode sufficiently high in alloy content to produce a deposit bearing approximately 9% chrome and 0.9% carbon. This alloy content results in a weld metal deposit which is essentially martensitic.

Operators will find that the exceptionally fine arc action of Airco No. 388 increases both the speed and quality of their work.

FOR RESISTANCE TO EXTREME EARTH ABRASION
Airco Tungtube
Nos. 8, 10, 20, 30 and 40

These are fabricated rods of tungsten carbide particles encased in a steel sheath. The various Tungtube numbers indicate the screen size of the tungsten carbide particles contained within the tube. With its extreme hardness tungsten carbide ranks second only to the diamond in earth cutting efficiency. It is accepted as the standard means of cutting non-metallic substances; such as, coal, shale, and granite. It is recommended for core bits, fishtail bits, road plows, coal cutter knives, plow shares and similar equipment subjected to extreme earth abrasion.

CORROSION – ACID RESISTANT ALLOYS FOR WELDING HARDER GRADES OF ALUMINUM BRONZE
Airco Nos. 100, 116, 120, 125 and 130 Electrodes

For joining aluminum bronze or other metals and combinations of dissimilar metals – and for overlays on bearing surfaces, machine parts, dies, etc. The deposits made with these electrodes are corrosion and acid-resistant and will also retard wear from abrasion and impact.

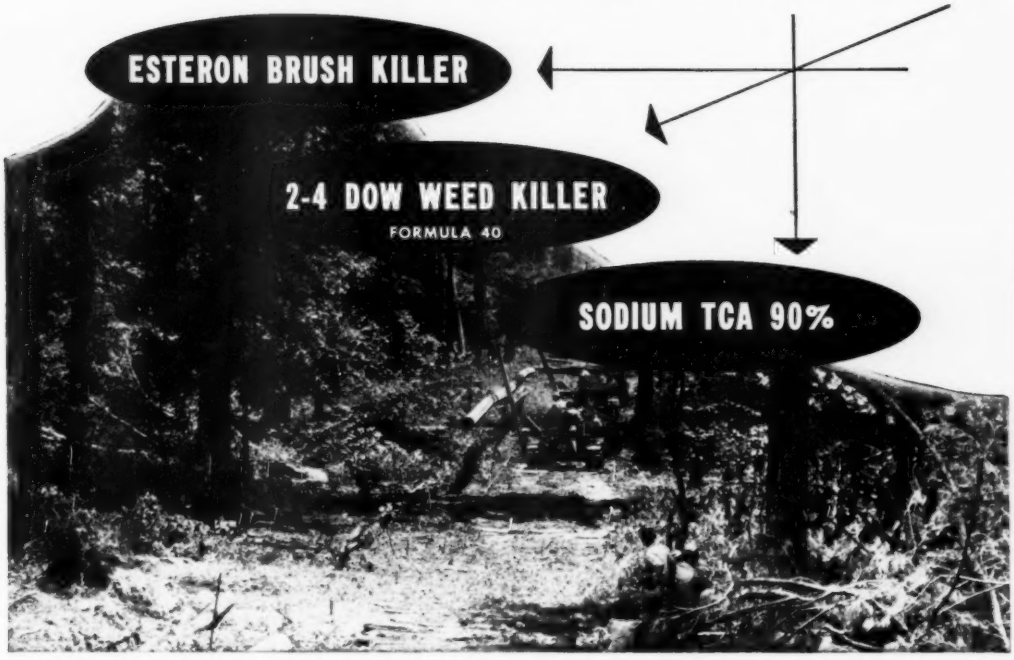
AIRCO

AIR REDUCTION MAGNOLIA COMPANY

A Division of Air Reduction Company, Incorporated

Houston • Beaumont • Corpus Christi • Wichita Falls
El Paso • Fort Worth • San Antonio • Dallas

Effective — Economical for Right-of-Way Maintenance



Clearing the way for the nation's pipelines is a big job! And it's a job that is never finished, for there is the continuous problem of keeping down undesirable vegetation.

The answer is found in not one—but *three*—Dow weed control products.

A right-of-way may be progressively cleared of woody vegetation when maintenance crews depend upon Esteron Brush Killer. This powerful Dow ester formulation has proved its effectiveness as a foliage spray on tough, woody growth, and when applied directly to cut stubs and stumps it will control resprouting. Where woody brush and brambles are not a problem—2-4 Dow Weed Killer, Formula 40 gives effective control of a long list of annual and perennial weeds growing in right-of-ways and around tank farms.

Sodium TCA 90% CONTROLS GRASSES

May be used around booster stations, tank farms, near gate valves—wherever tough, perennial grasses are a problem. May be combined with 2-4 Dow Weed Killer, Formula 40 or Esteron Brush Killer for weed, brush and grass control *at one spraying.*

Write to Dow for complete information.

Agricultural Chemical Division

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

DOW

CHEMICALS

INDISPENSABLE TO INDUSTRY AND AGRICULTURE

USE DEPENDABLE DOW AGRICULTURAL CHEMICAL PRODUCTS

WEED AND GRASS KILLERS • INSECTICIDES • FUNGICIDES
SEED PROTECTANT • PLANT GROWTH REGULATORS
GRAIN AND SOIL FUMIGANTS • WOOD PRESERVATIVE

a Profit-Winning Combination

MACK TRUCKS

plus the BALANCED BOGIE

YOU GET THEM *All* WITH THE *Balanced Bogie*

POWER DIVIDER: Positive traction regardless of terrain

INTER-AXLE DIFFERENTIAL: No wind-up or overstress of driving parts

RUBBER SHOCK INSULATORS: No spring twist . . . no lubrication

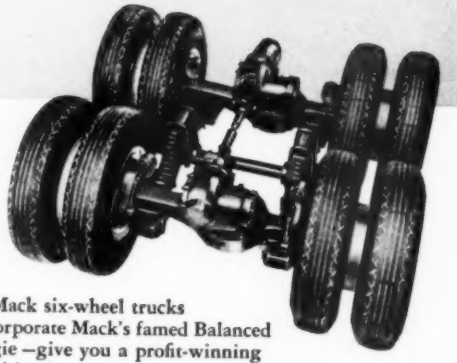
MAXIMUM FLEXIBILITY: No chassis distortion

SELF STEERING: No tire scuffing

UNIFORM TIRE LOADING: Longer tire life

UNIFORM BRAKING: Better control
No weight transfer between axles
No bogie hopping, rearing or toe-stubbing

SIMPLICITY OF DESIGN: Achieves minimum maintenance



• Mack six-wheel trucks incorporate Mack's famed Balanced Bogie—give you a profit-winning combination under the most adverse hauling conditions. Here is no makeshift assembly – but a bogie that is a component and integral part of the complete truck unit.

No other trucks – for operation on or off the highway – offer you all the outstanding advantages you get with the Balanced Bogie in Mack six-wheelers.

Check them for yourself. They're your assurance of trouble-free, uninterrupted schedules; lower costs and increased profits. For the full story, see your nearest Mack branch or distributor.

Be Profit-Wise

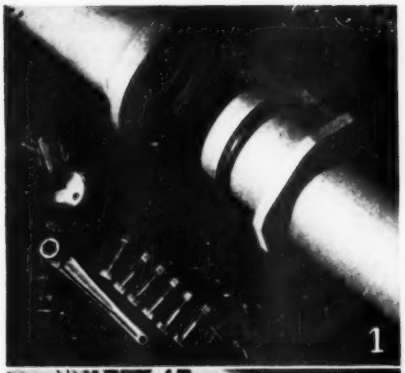
modernize with

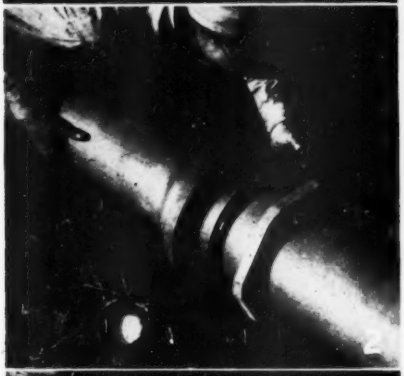
Mack

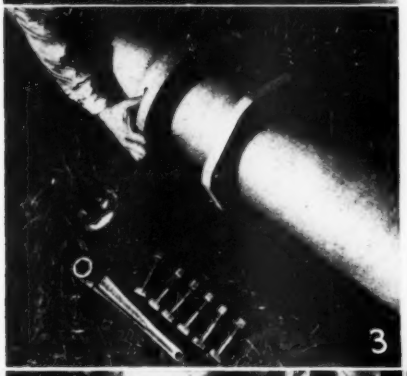
outlasts them all

8050

Mack Trucks, Inc., Empire State Building, New York 1, New York. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.







DOUBLEX SIMPLEX PIPE

for

High Pressure Service

Mono-Cast pipe with Doublex Simplex joints meets the exacting requirements of high pressure service. Manufactured under rigid specifications in diameters 3-inch through 48-inch, it is corrosion resistant, will stand the impact of heavy loads and gives complete job satisfaction.

Long service with minimum maintenance, coupled with simplicity in installation, makes Doublex Simplex pipe a favorite for systems conveying gas, oil, water, sewage or other liquids.

The Doublex Simplex joint is easily and quickly made. The accompanying pictures illustrate the method of making it up.

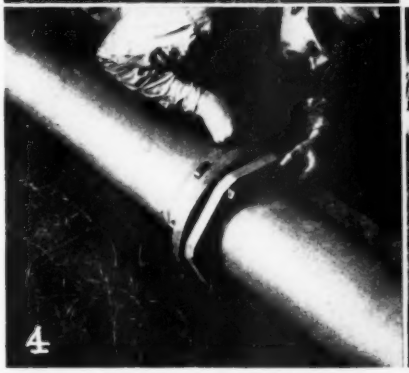
1. Shows materials and tool necessary for making the joint.
2. Lubricant is being applied to the gasket.
3. Pushing gasket into position.
4. Inserting bolts.
5. Final tightening with wrench.
6. The completed joint.

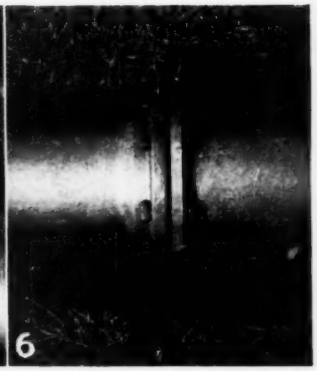
You can now get prompt delivery of Doublex Simplex pipe. Write for free literature.

•

AMERICAN CAST IRON PIPE COMPANY

Birmingham 2, Alabama



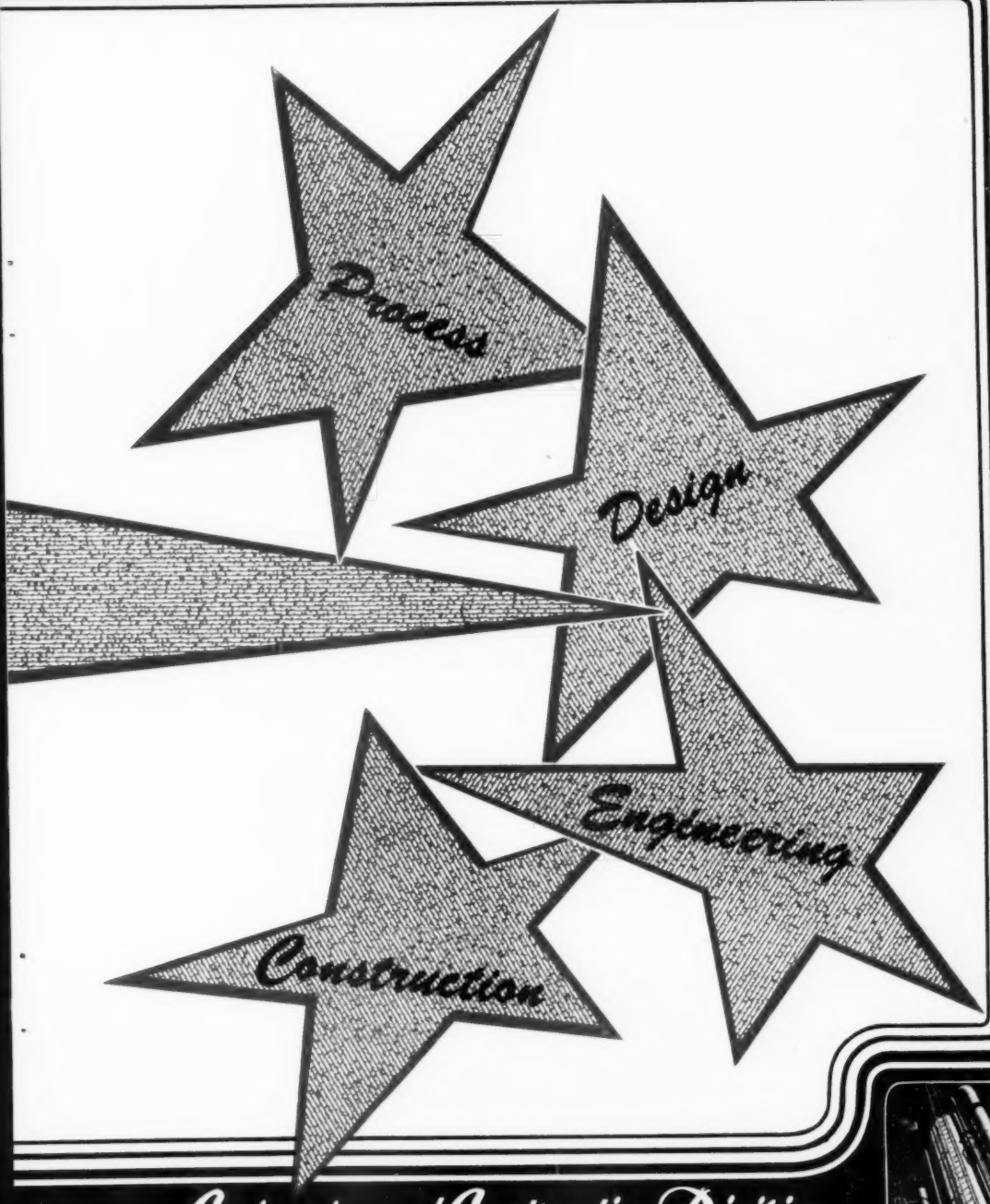


Maximum recovery and minimum operating expense are never accidental qualities in a petroleum processing plant.

The economical accomplishment of successful processing calls for experience as well as technical knowledge and conscientious procedure. There are no substitutes.

We are qualified to design and erect many types of petroleum processing plants. We welcome undivided responsibility for process selection, design, engineering, and construction. Our credentials are the plants we have built.

We serve you best when allowed to counsel with you from the time your need for a plant becomes obvious.



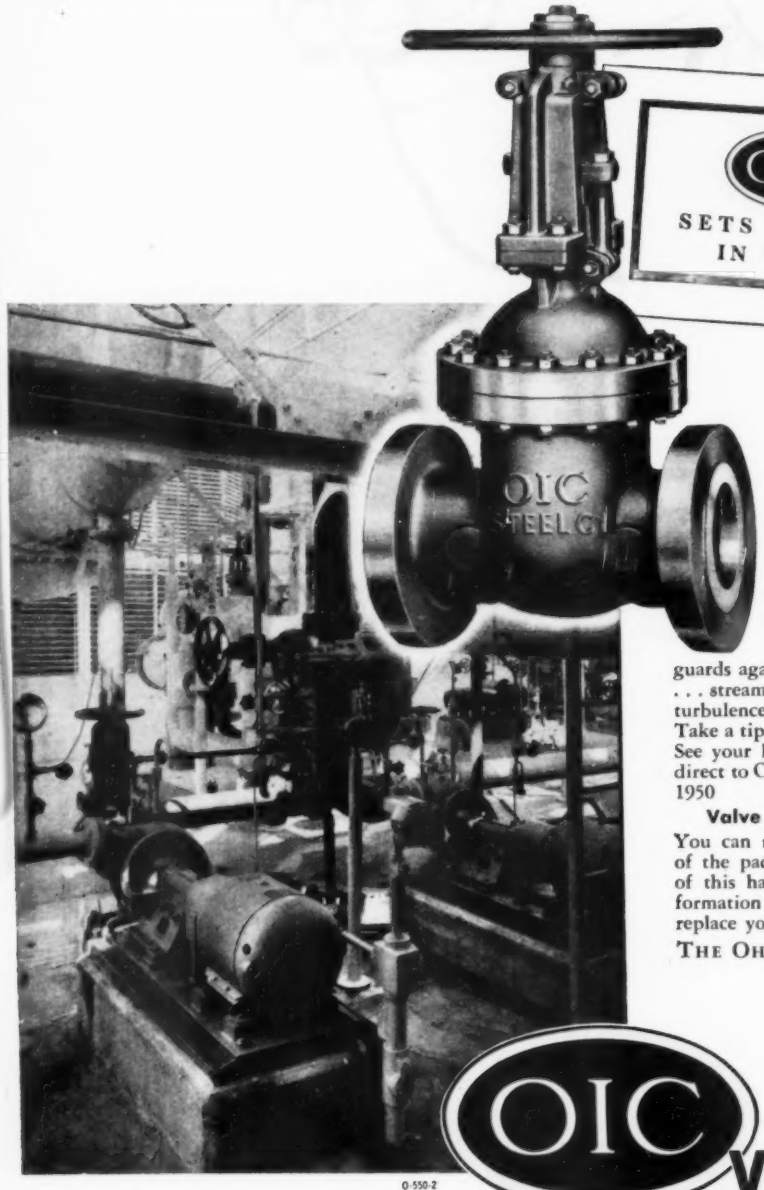
Engineering and Construction Division

JONES & LAUGHLIN SUPPLY COMPANY

TULSA, OKLAHOMA

Serving

THE PACE-SETTERS OF INDUSTRY



O-550-2

SHELL CHEMICAL Corporation uses these OIC gate valves on fluid transfer equipment at its Deer Park, Texas plant. The famous OIC free-flow feature guards against disastrous pressure-drop . . . streamlined designs protect against turbulence, reduce vibration and wear. Take a tip from the leaders of industry. See your local OIC distributor. Write direct to OIC for your copy of the new 1950

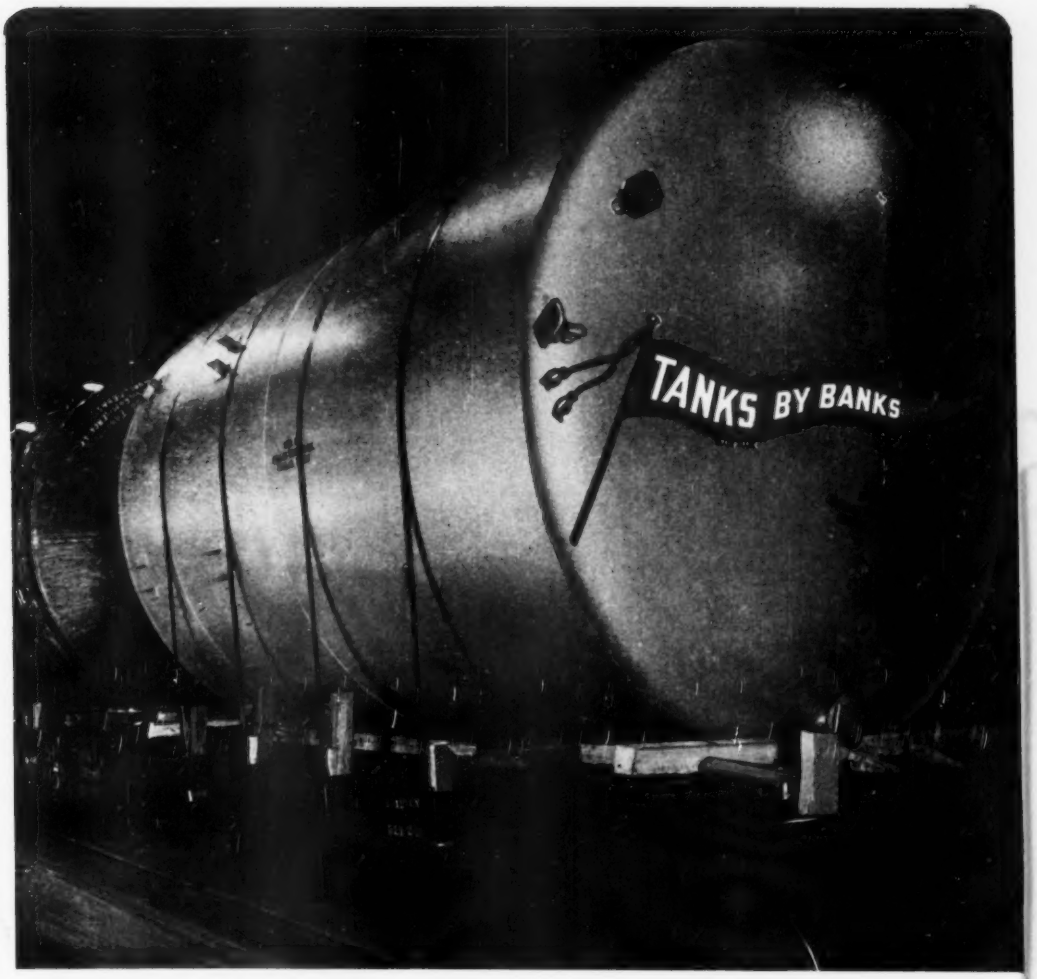
Valve Cross Reference Chart

You can make your trial applications of the pace-setting line with the help of this handy chart. It offers you information on the *right* OIC figures to replace your present valves.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

OIC VALVES

FORGED STEEL • CAST STEEL • IRON • BRONZE



A FAMOUS NAME ON FINE EQUIPMENT

The Red Pennant . . . with its slogan is a symbol of finest quality materials and engineering leadership. It is your guarantee of lasting satisfaction!

Write for complete information

DALLAS TANK COMPANY, INC.

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DALLAS, TEXAS

For Long

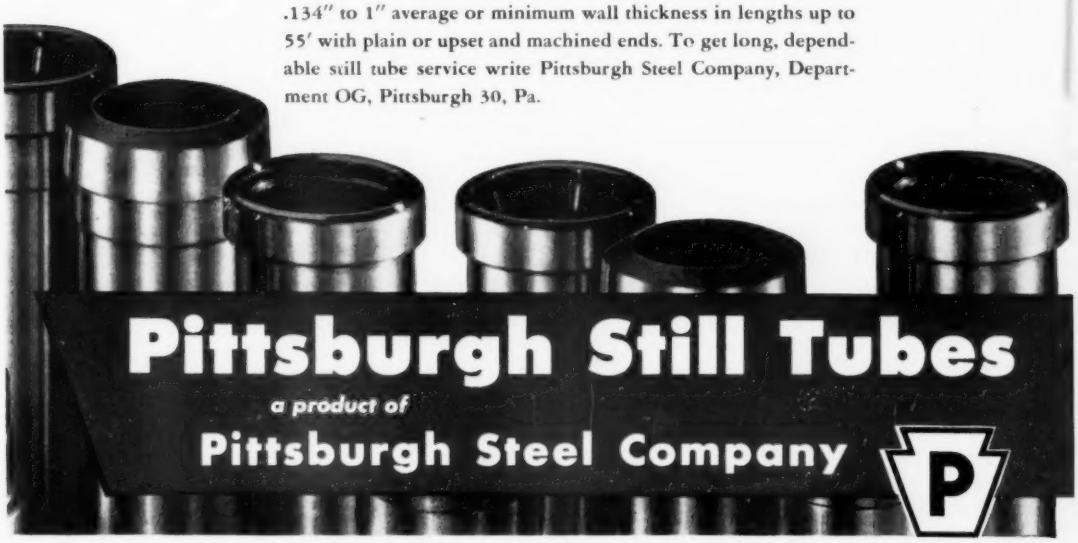
Dependable Service

Specify

Pittsburgh Still Tubes

You get long dependable service when you install Pittsburgh Still Tubes in your refinery equipment. They are produced especially to resist the severe heat, pressure and corrosive action of your operations—with economy. Numerous grades of alloy steels ranging from low molybdenum and intermediate chrome-molybdenum alloys to the higher grades—have been developed to meet your problems of creep strength corrosion and oxidation.

In order to take full advantage of the wide range of analyses, sizes and wall thickness available, our metallurgical engineers will be glad to work with you in specifying the proper tubes for your next installation. Pittsburgh Still Tubes are made in sizes from 2″ to 6″ outside diameter (in some cases even larger) from .134″ to 1″ average or minimum wall thickness in lengths up to 55′ with plain or upset and machined ends. To get long, dependable still tube service write Pittsburgh Steel Company, Department OG, Pittsburgh 30, Pa.



Product-Wise SERVICE for Petroleum Shippers

Special knowledge in shipping of petroleum products is one of the important tools of our business. Added to 40 years of railroad transportation experience, it enables us to supply you with tank cars scientifically designed to protect your products enroute to market. It also enables us to serve you expertly and efficiently at all times, making possible the utilization of our equipment for the maximum benefit of all petroleum shippers. Consult experts at any one of our offices listed below. They'll help you solve your shipping problems.

NORTH AMERICAN CAR CORPORATION

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A nation-wide organization with branch offices in important market centers

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681 Market St., San Francisco, Calif.
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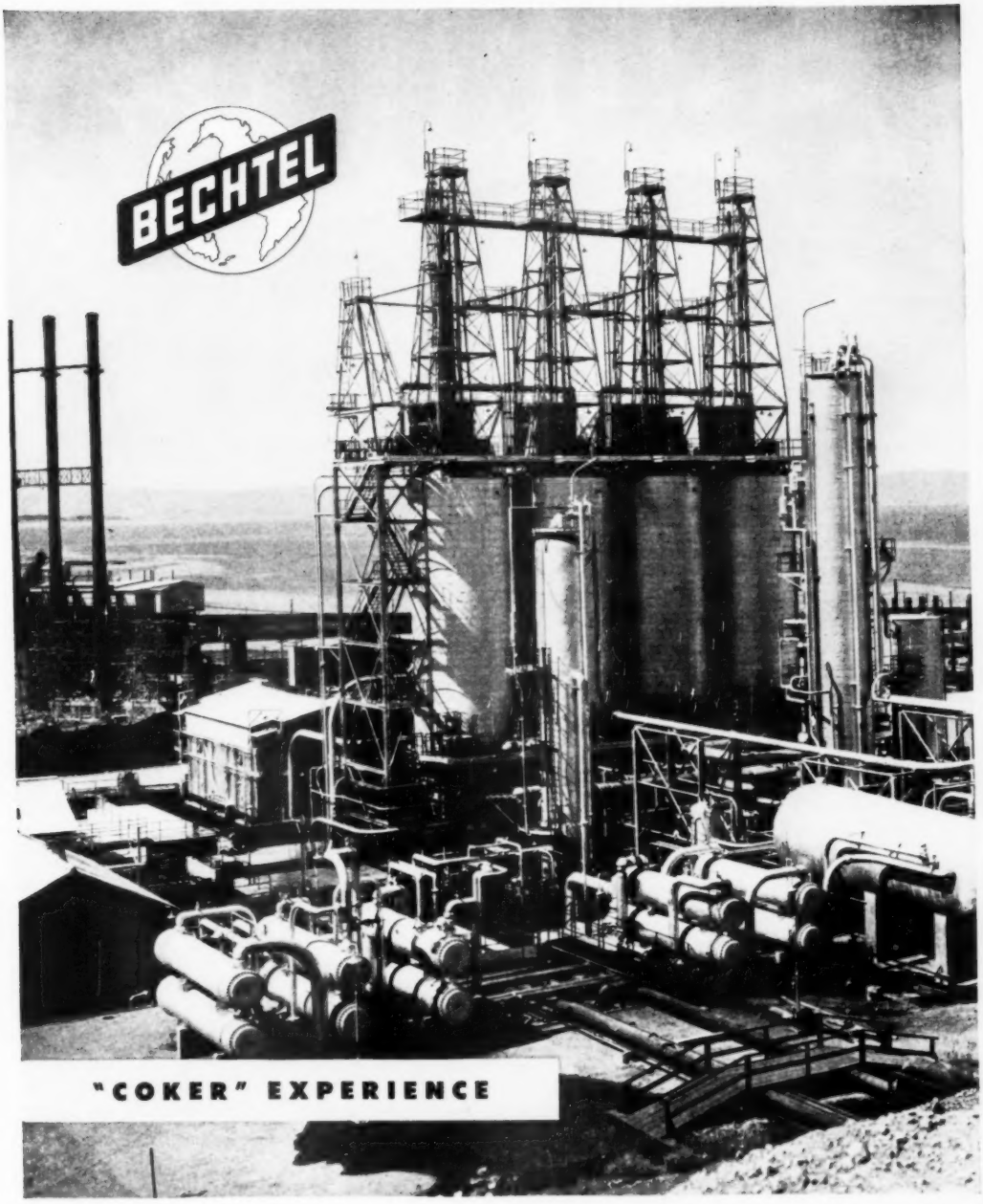

The coker shown above was Bechtel-built in 1942. Currently, Bechtel experience is being applied to coker projects under construction in the midwest and on the Pacific Coast, and is available wherever a refinery development is contemplated.

BECHTEL CORPORATION

Los Angeles • **SAN FRANCISCO** • *New York*
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"BUILDERS FOR INDUSTRY"

DESIGN • ENGINEERING • CONSTRUCTION

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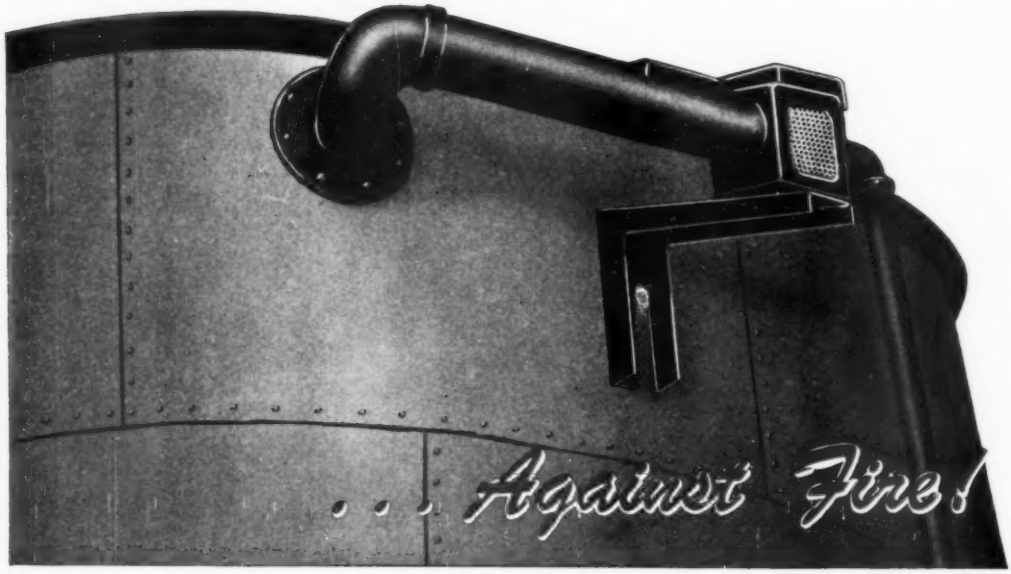

WITH THE FOAMITE AIRFOAM SYSTEM

Flammable liquid tanks are secure against fire when adequately protected by a correct installation of the Foamite Airfoam System. Each System is specially engineered by Alfco experts to suit the individual needs of a particular risk. The Foamite Airfoam System supplies tenacious, long-lasting, blaze-smothering Foamite Airfoam in ample quantities for quick, complete extinguishment.

The System may be connected to protect more than one risk. It is scientifically designed for the correct mixing of Foamite Airfoam Liquid, water, and air, to produce ten gallons of Foamite Airfoam for each gallon of 6% Foamite Airfoam Solution. Solutions are mixed by either of two types of proportioners — the Foamite Airfoam In-Line Proportioner for tanks not requiring extensive piping, and the Around-the-Pump Proportioner for use where long supply lines involve pressure losses. The Foamite Trough for fixed Systems, and Foamite Airfoam Applicators for portable use, facilitate foam delivery, insure flexibility of Foamite Airfoam System arrangements.

Another valuable portable Foamite Airfoam unit is the Foamite Airfoam-Generating Nozzle, which creates Airfoam by drawing Foamite Airfoam Liquid from a pick-up tube, mixing it with water to the necessary 6% Foamite Airfoam Solution, and agitating it with air. All Foamite Airfoam devices approved by Underwriters' Laboratories, Inc. Write for free 24-page booklet of engineering data.

With Total Confidence of Dependability in FIRE PROTECTION

AMERICAN-LAFRANCE-FOAMITE Corporation

ELMIRA-NEW YORK-U.S.A.

ALFCO

SEAMLESS WELDING FITTINGS
½-inch through 36 inches
Standard through Double Extra Strong

FORGED STEEL FLANGES
½-inch through 30 inches
150 lbs. through 2500 lbs. pressure

FORGED STEEL FITTINGS
Screwed and Socket Welding
⅛-inch through 4 inches
2000 lbs. through 6000 lbs. pressure

TO MARK PROGRESS

LONG WELDING NECKS
1-inch through 24 inches

LARGE O.D. FLANGES
26 inches through 96 inches

Ladish...one place to get them all

Available in
CARBON
ALLOY
STAINLESS STEELS
ALUMINUM
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and OTHER
NON-FERROUS
METALS

Whatever the piping job . . . Ladish is prepared to supply your fittings needs. Here is the one line that offers them all . . . Seamless Welding Fittings, Forged Steel Flanges, Forged Steel Fittings, Large O. D. Flanges and Long Welding Necks . . . in an unrestricted selection of types, sizes, weights, pressure ratings and materials. Standardizing on this complete line not only simplifies procurement but also assures you of added dependability by protecting every joint of the system through use of Ladish Controlled Quality Fittings.

A COMPLETE LINE PRODUCED UNDER ONE ROOF
. . . ONE RESPONSIBILITY

LADISH CO.
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MILWAUKEE SUBURB

DISTRICT OFFICES: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
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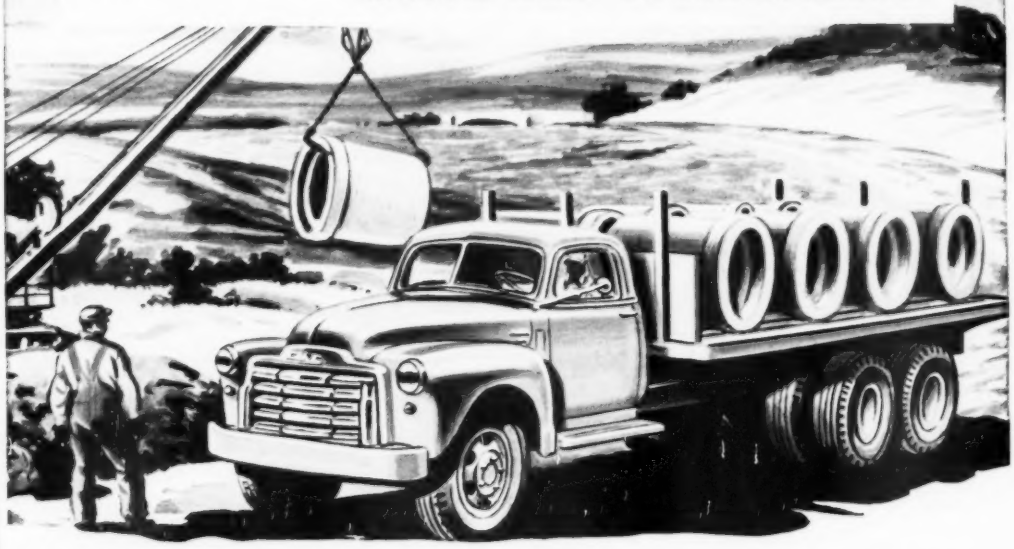
New "MIDDLE-WEIGHT" GMC SIX-WHEELERS



Bringing the Advantages of Dual Drive Design to Many More Truck Operators

Here's welcome news for oil field operators, pipe line operators and other truck users who need trucks that combine great tractive ability with low gross vehicle weight.

These new GMC series "400" and "620" 6-wheelers answer every requirement of these vocations. In the bargain they give you the plus values of GMC engineering and design . . . in powerful valve-in-head engines that are basically the same as "the Army's Workhorse" . . . in modern, wide-vision, extra comfort cabs . . . in rugged, truck-built chassis that include such outstanding features as wholly new, high efficiency dual drive axles, bumper bar grilles, recirculating ball bearing steering, Syncro-Mesh transmissions, frames of 11.1 and 16.03 section modulus.

These new GMCs offer a long-desired lower cost way of hauling big loads, on or off the roads. Let your GMC dealer give you the highly acceptable facts and figures for your particular job.

GMC TRUCK & COACH DIVISION • GENERAL MOTORS CORPORATION

GMC
GASOLINE • DIESEL
TRUCKS

24,000 and 32,000 pounds GVW
•
248 and 270 Engines of 110 and 120 h. p.
•
360 and 426 Engines of 150 and 177 h. p.
•
All-New Rugged Dual Drive Rear Axles
•
Four- and Five-Speed Syncro-Mesh Transmissions
•
New Heavy Duty Hydraulic and Air Brakes

ATLAS CHAIN HAS LONGER LIFE!

Run roller chains through your hands and they all look alike. Put Atlas Chain under a microscope and you'll see the difference!

A metallographic microscope will reveal that all of the parts of Atlas Roller Chain are made of carefully selected steels . . . and scientifically heat treated for longer wear. Parts subject to excessive wear are treated to be tough by the special "Nicarb" Process. The effects of "Nicarbing" are revealed by the surface which combines the advantages of both carburizing and nitriding.

An outer rim of nitride needles knits together a base of carbide particles and binds them strongly to the core of steel. This nitride enriched outer surface, along with the binding qualities induced, proves by test to impart greater strength and wear resistance than conventional hardening. In addition, all parts take on an unusual resistance to corrosion and oxidation.

If you are interested in boosting the life of chain drives on your products or machines, take advantage of the longer life built into every link of Atlas Chain. Call in an Atlas representative for further details. Prices and specifications are available in our new catalog. Write for your free copy.

Conventional Hardening

ATLAS CHAIN & MANUFACTURING CO.

CASTOR & KENSINGTON AVENUES PHILADELPHIA, PA.

HOW TRACKSON Super-Inch Special Pipe Layers Serve Bechtel, Price, Conyes Corp.

This "Biggest-Inch", 34" in diameter, pipe line will transport natural gas from Texas to San Francisco Bay area. World's largest high-pressure gas line, the huge tube is 7/16" thick, weighs 192 pounds per foot uncovered!

▶Pipe Liners sock giant loads to the Model MDW8 PIPE LAYER'S blocks — and know this Super-Inch Special TRACKSON PIPE LAYER will take it safely. For the MDW8 is powered by a special offset track "Caterpillar" D8 Tractor; is built for the heaviest Super-Inch pipe line duty.

The Super-Inch Special gets its tremendous lifting capacity by: (1) the specially-built 92" gauge D8 tractor with offset track; and (2) the hydraulically-controlled counterweight, which is quickly extended for maximum lift — and as quickly retracted for clearing obstructions.

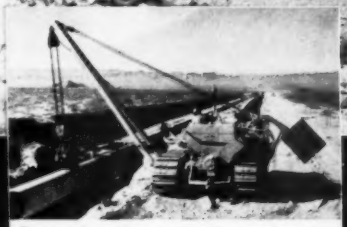
The offset boom-side track frame, equipped with extra-wide track shoes, gains flotation for soft going; and minimizes cave-ins. The MDW8's 3 forward, and one reverse, speed transmission; its soft, smooth-acting brakes; responsive, properly-placed control levers — assure gentle, precision handling of big loads.

This combination of MDW8 features enables Bechtel, Price, Conyes Corporation to lay 9000 feet of "Biggest Inch" pipe per day, in tough terrain! According to the "Bechtel Press", "It takes record breaking machines to handle this record breaking job!"

See your TRACKSON-"Caterpillar" Dealer for full information on the Super-Inch Special and the other 4 TRACKSON PIPE LAYER Models. Or write direct to TRACKSON Company, Dept. OG-30, Milwaukee 1, Wis.

A fleet of Super-Inch Special PIPE LAYERS team to handle 192-pound-per-foot, 34" line on the "Biggest Inch". Outfits owned by Bechtel, Price, Conyes Corp.

TRACKSON
TRACTOR EQUIPMENT



Boom-side offset track of special wide-gauge D8 plus hydraulically-controlled counterweight gives MDW8 PIPE LAYER lifting capacity for sure, safe handling of big, heavy line pipe.

to give true economy in salt removal a desalting process must provide

MAXIMUM PERFORMANCE...

Getting "most of the salt" is not enough. In every installation Petreco engineers aim at 100% removal — and they're getting it, or closely approaching it, time after time. Some Petreco users now install desalters to treat crudes considered "comparatively salt free" only a few years ago. *Maximum salt removal permits top refining efficiency—you get PERFORMANCE with PETRECO.*

COMPETENT SERVICE...

Petreco engineers supervise construction on every installation. Petreco resident engineers are on 24-hour emergency call. Petreco research technicians and laboratory facilities are always ready to assist refiners on salt problems. Petreco engineers regularly inspect the desalting equipment and check its performance. Petreco warehouses replacement parts close to all major refining centers. *You get SERVICE with PETRECO.*

FAST PAY OUT...

One refiner states that Petreco Desalting "paid out" in *three months!* Another cited a *five months* payout. Payouts such as these represent substantial savings for any refiner charging salty crudes. The reasons most frequently cited for Petreco's fast payout are: Less plugging in crude furnaces, heat exchangers and reduced crude furnaces; less corrosion in topping units. *You get FAST PAY-OUT with PETRECO.*

OPERATIONAL FACTS...

If you have a desalting problem, ask Petreco for facts and figures—Petreco engineers can tell you why Petreco desalters deliver such high removal percentages, how Petreco Service is designed to help you, and why, how and where Petreco Desalters have more than paid their own way. *Get facts! They're available from*

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5121 S. WAYSIDE DRIVE • HOUSTON 1, TEXAS
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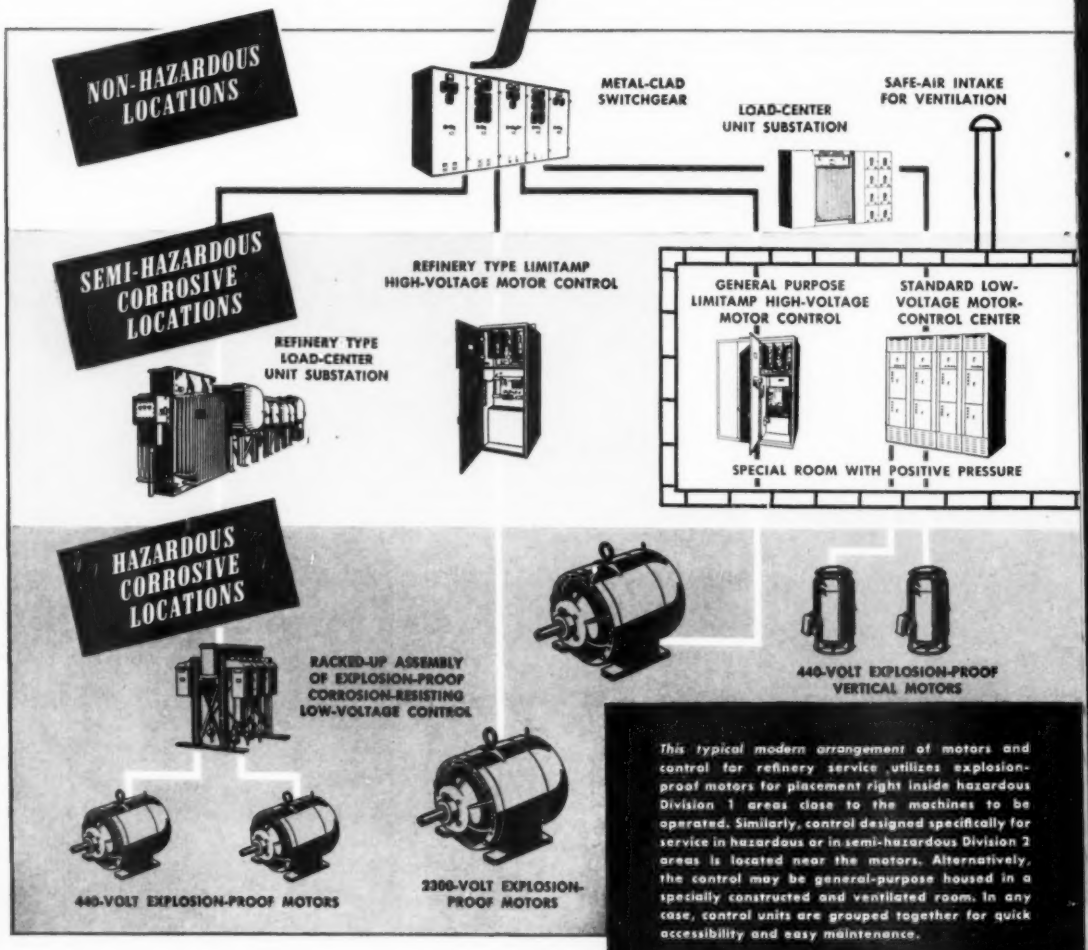
PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 50-2

What's the trend in refinery electrification? } wider use of explosion-proof


NON-HAZARDOUS LOCATIONS
METAL-CLAD SWITCHGEAR
LOAD-CENTER UNIT SUBSTATION
SAFE-AIR INTAKE FOR VENTILATION
SEMI-HAZARDOUS CORROSIVE LOCATIONS
REFINERY TYPE LIMITAMP HIGH-VOLTAGE MOTOR CONTROL
REFINERY TYPE LOAD-CENTER UNIT SUBSTATION
GENERAL PURPOSE LIMITAMP HIGH-VOLTAGE MOTOR CONTROL
STANDARD LOW-VOLTAGE MOTOR-CONTROL CENTER
SPECIAL ROOM WITH POSITIVE PRESSURE
HAZARDOUS CORROSIVE LOCATIONS
RACKED-UP ASSEMBLY OF EXPLOSION-PROOF CORROSION-RESISTING LOW-VOLTAGE CONTROL
440-VOLT EXPLOSION-PROOF VERTICAL MOTORS
440-VOLT EXPLOSION-PROOF MOTORS
2300-VOLT EXPLOSION-PROOF MOTORS

This typical modern arrangement of motors and control for refinery service utilizes explosion-proof motors for placement right inside hazardous Division 1 areas close to the machines to be operated. Similarly, control designed specifically for service in hazardous or in semi-hazardous Division 2 areas is located near the motors. Alternatively, the control may be general-purpose housed in a specially constructed and ventilated room. In any case, control units are grouped together for quick accessibility and easy maintenance.

Here's what you need in motors and control for hazardous areas! }

WHEN YOU COME TO GENERAL ELECTRIC you get far more than the finest in electrical equipment. A General Electric application engineer, familiar with refinery practice, is at your disposal. If desired, he stands ready to take over the job of co-ordinating all the needed components, engineering your power distribution and utilization equipment into one modern, efficient system.

corrosion-resisting **motors and grouped controls**

—to simplify plant layouts, cut special construction costs!

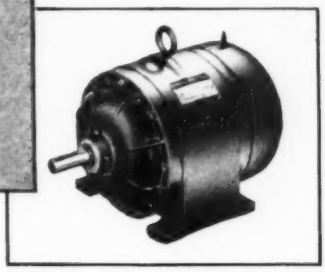
There are more ways than one, of course, to meet hazardous refinery conditions. But because it best combines simplicity, security, and savings, today's trend is toward greater use of explosion-proof, corrosion-resisting motors and group installation of control centers.

Its advantages? Motors and control can be located solely with reference to convenience, accessibility for maintenance, economy of space, and driving machinery. And because it's standard equipment, initial cost is lower.

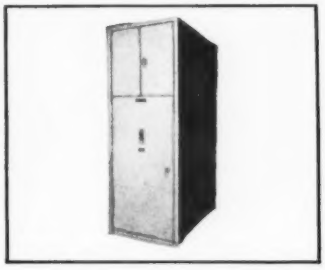
By minimizing explosion hazards, you promote personnel safety and continuity of production. Moreover, you can take full advantage of the cost-saving benefits of the load-center system of power distribution. Full information on motors and control for hazardous areas is contained in Bulletin GEA-4131. We'll gladly send you a copy. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Have you seen the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution"? Ask your G-E representative to arrange a showing for your organization.

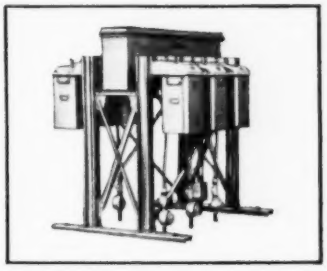
To meet refinery conditions and code requirements for hazardous areas, General Electric builds the most extensive line of explosion-proof motors on the market, in the widest variety of types, sizes, and ratings, and for the greatest number of hazardous conditions. In high- and low-voltage control, too, you have an unusually broad range to select from, made especially for use in hazardous and corrosive atmospheres. Let an experienced G-E engineer help you select the right combination for *your* special needs. Take the first step now—just call him at your nearest G-E office.



G-E Tri-Clad explosion-proof motors for Class I Group D hazardous locations have strong cast-iron frames and end shields. Non-sparking Textolite cooling fans standard on smaller sizes for greatest corrosion resistance.



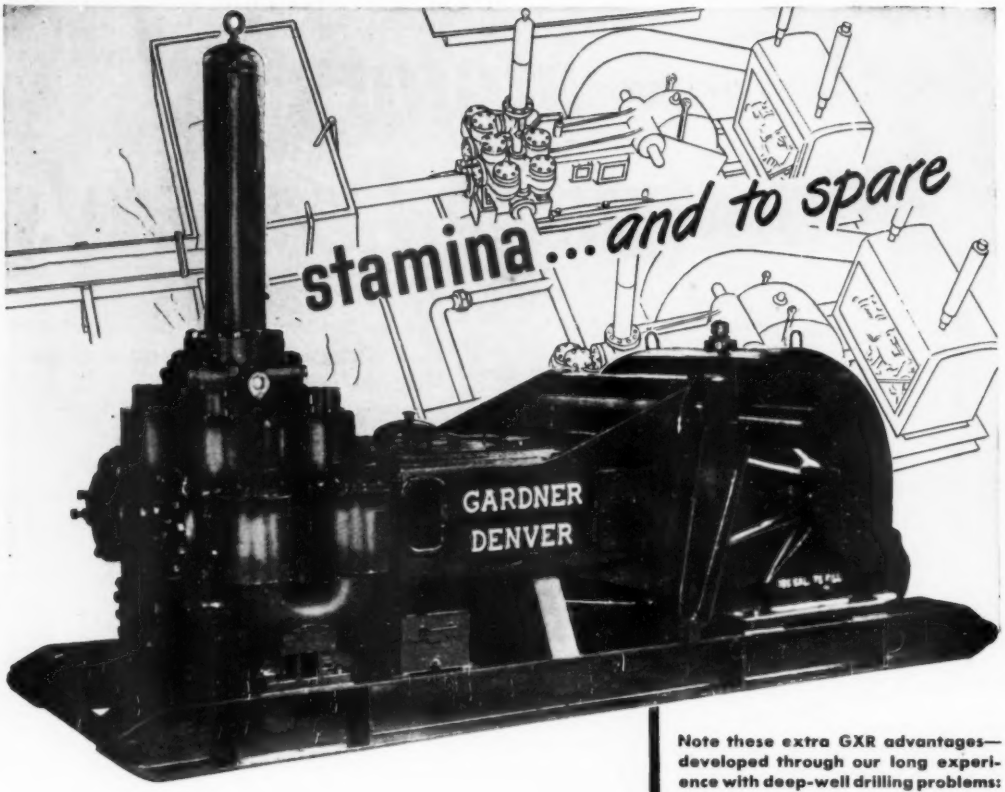
G-E Limitamp high-voltage motor controls for semi-hazardous Class I Group D Division 2 areas—factory-assembled, space-saving units—give adequate short-circuit protection with high-IC current-limiting fuses.



G-E low-voltage control for hazardous Class I Group D Division 1 areas—in these convenient, racked-up standard assemblies of combination starters and breakers—save installation time, simplify maintenance.

GENERAL ELECTRIC

661-5



new

GARDNER-DENVER GXR POWER SLUSH PUMP!

Keep up mud circulation—all the way down—with the new Gardner-Denver GXR Power Slush Pump—the 650 horsepower pump that's engineered for the record-shattering holes of today and tomorrow. The GXR is built with a generous reserve of power and stamina for handling circulation emergencies with complete safety and absolute reliability. For complete information, write us today.

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Since 1859

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Export Division: 30 Rockefeller Plaza, New York, N. Y.
Republic Supply Co. (of Calif.), 2600 S. Eastland Ave., Los Angeles, Calif.

Note these extra GXR advantages—developed through our long experience with deep-well drilling problems:

new Double helical drive gears—accurately aligned by heavy-duty spherical roller bearings.

new Sturdy, one-piece connecting ro[d] made of heat-treated alloy steel. Renewa[ble] bushings in both ends.

new Screwed type stuffing box glands and lantern spacer for rod lubrication—protect highly finished piston rods.

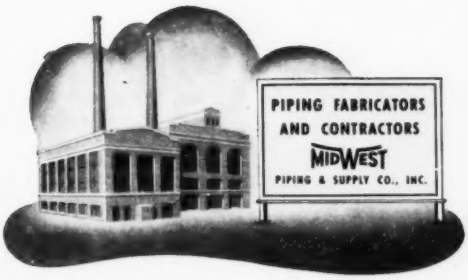
new Clean, filtered oil fed under pressure—assures positive lubrication.

new Interchangeable right and left liquid cylinders—simplify stock and maintenance problems.

new Screwed type valve pot covers—save time on every valve inspection.

new Liquid manifold designed for separate suction and discharge surge chambers when required.

... Plus many time-proved features of the world-famous Gardner-Denver FX Power Pumps.



FIRST-HAND EXPERIENCE IN THE FIELD

Helps Maintain the HIGH QUALITY of

MIDWEST

PRE-FABRICATED PIPING

Midwest not only has a pipe fabricating organization of exceptional skill . . . it also has a Construction Department which has been erecting all kinds of piping for 48 years.

As a result, our shops get continuous first-hand field reports on the erection of fabricated piping. Our Construction Department constantly keeps us mindful of the importance of accurate alignment, thorough cleaning, careful inspection and testing of all bends, welded subassemblies, etc., before they leave the shops.

This situation has been of immense value in maintaining the high quality of Midwest Piping. The Construction Department also is the source of countless suggestions for improvement in pressure piping. All Midwest customers benefit from the accumulation of these suggestions.

Midwest, with four fabricating plants strategically located, has nationwide experience in satisfying the piping needs of all industries. You will always find it advantageous to use Midwest Pre-Fabricated Piping . . . either when purchased on the basis of materials only or piping completely installed.

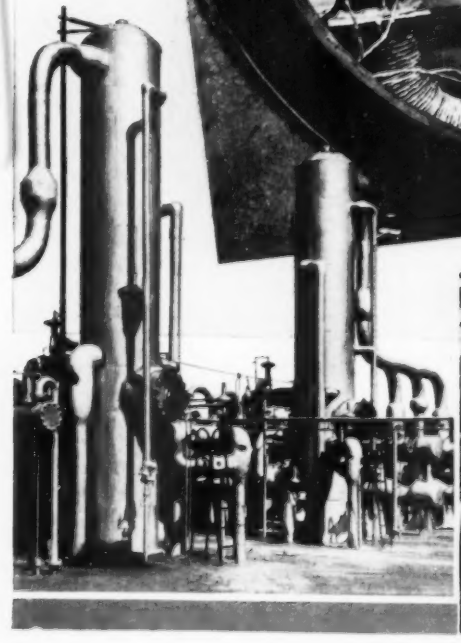
MIDWEST PIPING & SUPPLY CO., INC.
MAIN OFFICE: 1450 SOUTH SECOND ST., ST. LOUIS 4, MO.

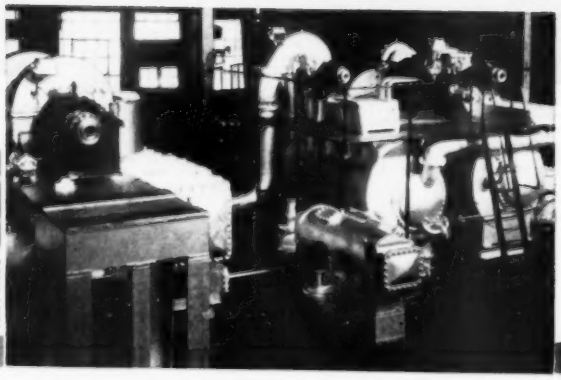
Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—79 West Monroe St. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. Tulsa 3—533 Mayo Bldg. • South Boston 27—427 First St.

PIPING FABRICATORS AND CONTRACTORS

3480

Some high-lights on alloy steels





for low temperature applications

If you manufacture equipment, machinery or apparatus that must operate at sub-zero temperatures . . . if you are building tanks and vessels for the storage or transportation of liquefied gases—*we can help you.*

IN recent years, steels for low temperature service have been receiving more and more attention. And deservedly so.

Their importance has been emphasized by the increased development of low temperature processing, as in the dewaxing of oils; by the obvious advantages of storing, in liquefied form, gases such as oxygen, hydrogen, nitrogen, natural gas, propane and butane; and finally, by the realization of the imperative need for a safe constructional material for railroad equipment, aircraft, tractors, motor trucks, road building machinery and other equipment that must operate in very cold climates.

The property which is most affected by low temperatures is resistance to shock or impact. At sub-zero temperatures, the mechanical properties of steel generally change as the temperature is lowered. Such properties as ultimate tensile or yield strengths generally will increase. However, the impact properties may, and frequently do, drop more than would be satisfactory if severe shocks were imposed.

Plain carbon steels are highly susceptible to embrittlement at extremely low temperatures. Low carbon nickel-alloy steels, however, offer higher resistance to shock under these conditions.

For example, the American Society for Testing Materials recognizes low carbon 2½% nickel steel for temperatures down to minus 75°F. and low carbon 3½% nickel steel for temperatures down to minus 150°F. Recently, a new, low carbon alloy steel containing higher nickel content has been developed which shows good toughness at much lower temperatures. This steel holds great promise for those processes which require equipment to operate at extremely low temperatures.

We manufacture these special alloy steels for low temperature application. They're available in billets, bars, plates and other flat rolled products, also in forgings and seamless tubing. If you contemplate the fabrication or use of equipment that must operate at sub-zero temperature, our service metallurgists will gladly give you the benefit of their experience.

•

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH & CHICAGO
COLUMBIA STEEL COMPANY, SAN FRANCISCO · TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Carilloy Steels

USS

ELECTRIC FURNACE OR OPEN HEARTH
COMPLETE PRODUCTION FACILITIES IN CHICAGO AND PITTSBURGH

UNITED STATES STEEL

Chemicals you live by

WE HELP SCRUB OIL PRODUCTS, TOO

A lot of DIAMOND ALKALI'S Caustic Soda helps make soap for scrubbing little boys' faces, but an increasingly larger amount of DIAMOND Caustic Soda flows into your refineries to help scrub gasoline and kerosene and for cleaning up petroleum fractions.

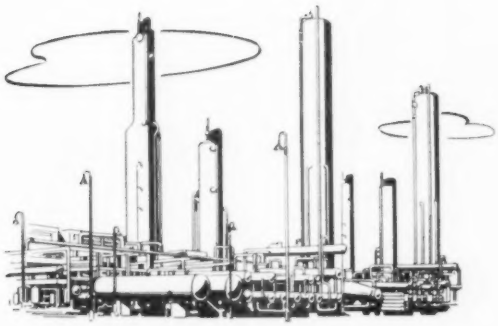
With the ever-growing emphasis on high quality and anti-knock values, caustic soda has become a chemical of prime importance to the refining industry.

To help meet your need for caustic soda, DIAMOND ALKALI last year completed its newest (and largest) electrolytic chemical plant at Houston. This plant, in combination with DIAMOND'S other caustic-chlorine plants at Pine Bluff, Arkansas, Painesville, Ohio, and Edgewood, Maryland, provides the oil industry with a flexible, dependable and speedy source of supply of both chlorine and caustic soda.

DIAMOND CHEMICALS FOR THE OIL INDUSTRY

DIAMOND ALKALI COMPANY • CLEVELAND 14, OHIO

DIAMOND ALKALI CHEMICALS



The New Slaughter Gasoline Plant

uses

PKVG

Gas-Engine-Driven Generator Units for supplying

ALL ELECTRIC POWER

Here, in one of the world's largest high-pressure casing-head gasoline plants at Slaughter Field, Texas, eight companies have united to obtain the most efficient utilization of natural gas. And here—as in so many other petroleum plants the world over—you'll find Ingersoll-Rand 4-cycle gas engines on the job 24 hours a day. Six powerful, economical Type PKVG engines drive six 800-kw, 2300-volt generators that supply all electric power for the entire plant.

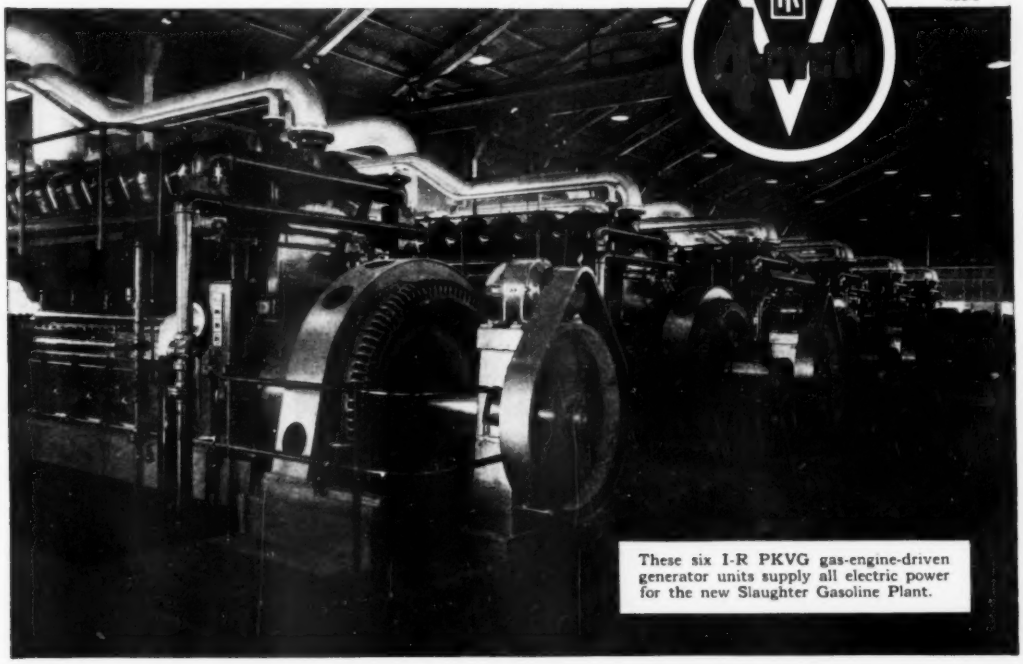
For simplicity, efficiency, smooth quiet operation, and rugged dependability, the PKVG has no equal. Ingersoll-Rand 4-cycle, V-design means maximum fuel and lubricating oil economies, and extra stability of power and close speed control at all loads. Simplicity and accessibility of all parts mean easier maintenance —and less of it. Built in 600 to 1320-hp sizes, the PKVG is conservatively rated and will handle any kind of load . . . and so will the smaller PVG, sizes 185 to 407 hp. For complete information, see your nearest I-R representative . . . or if you need gas-powered *compressors*, ask about the JVG, SVG, and KVG, sizes 110 to 1320 hp.

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • CONDENSERS • TURBO BLOWERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

488-6



These six I-R PKVG gas-engine-driven generator units supply all electric power for the new Slaughter Gasoline Plant.

TOOL UP WITH *Toledo Advantages* FOR THREADING 1" TO 2" PIPE!

Save Job-Time... Reduce Costs

Take the short and easier way to get perfect 1" to 2" threads—use a genuine TOLEDO Pipe Tool!

Many thousands of better mechanics today have used a *Toledo 1A Ratchet Threader* for years—a tool that's famous for efficiency, economy and dependability.

Others prefer the plus features of a Toledo 1BR Ratchet Threader . . . similar to the 1A, but also has pipe holder with broad faced chuck jaws easily set by wing-head thumb screws. Assures accurate centering and firm grip.

If you want a self-contained tool—use the finest of 'em all—Toledo SIMPACT! Threads clean and fast . . . one set of high speed steel dies does work of four . . . no loose parts . . . sizes changed instantly.

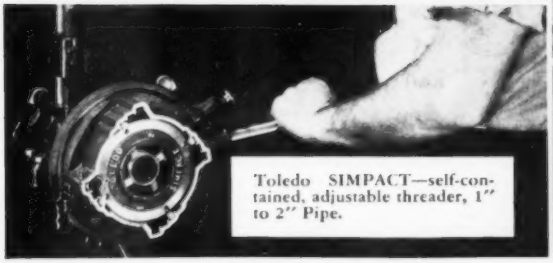
Whether it's hand tools or power equipment—get time-proven TOLEDO advantages for every pipe fitting requirement! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

RELY ON THE LEADER

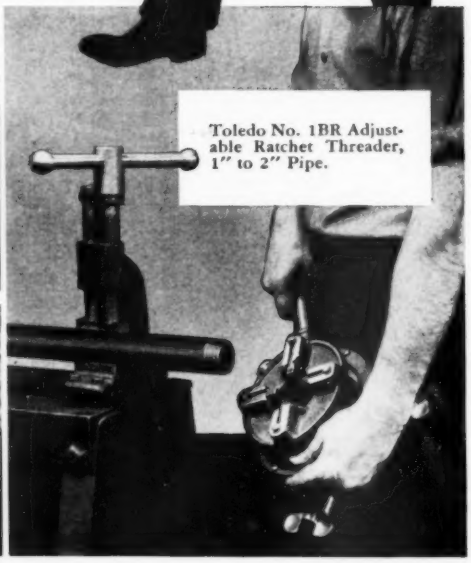
TOLEDO

FOR PRECISION PIPE TOOLS

Toledo No. 1A Adjustable Ratchet Threader, 1" to 2" Pipe.



Toledo SIMPACT—self-contained, adjustable threader, 1" to 2" Pipe.



Toledo No. 1BR Adjustable Ratchet Threader, 1" to 2" Pipe.

YOUR BIGGEST MONEY'S-WORTH IN OIL...

Comes to You from Competitive Efficiency like this!

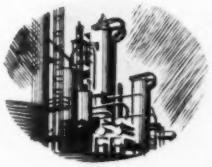
IN SOCONY-VACUUM'S OPERATION,

these major steps—from exploration to delivered product—are carefully co-ordinated to assure maximum efficiency all down the line, maximum savings for you.

First, find the oil—
To satisfy the growing demand, we must maintain a *constant search for new oil*. This in spite of the fact that we purchase large amounts of our crude oil needs from independent producers.

Then drill for it—
Even after oil is found, development of the field entails great cost. New wells must constantly be drilled to replace depleted wells—and so maintain petroleum supply.

Transport it to refinery—
Although we use other common carrier pipelines for transportation, in 1948 Socony-Vacuum laid 3,000 miles of *new* pipelines needed to reach new fields and improve distribution.



Refine it—
by the latest and most up-to-date processes, *geared for high capacity output*. Oil refinery equipment, by the way, which cost the company around $500 a barrel of capacity before the war, now costs $1,000.

Distribute it—
While we own and operate many ships, we also charter vessels and tank cars—rely on common and contract haulers. The combined result—maximum efficiency, lower cost to you.

And finally serve it—
Besides direct distribution, efficiency dictates the use of *over 1,400 independent wholesalers* and some *45,000 independent dealers* to whom of course we give expert technical and marketing counsel.

A STRONG NATION depends on strong Industries . . . strong Industries depend on strong Companies.

Socony-Vacuum — or *any* Company in America — is only as strong as its ability to *compete efficiently* in serving you . . .

. . . with productive power to help build National Security . . . with quality products at low prices to make your dollars buy more.

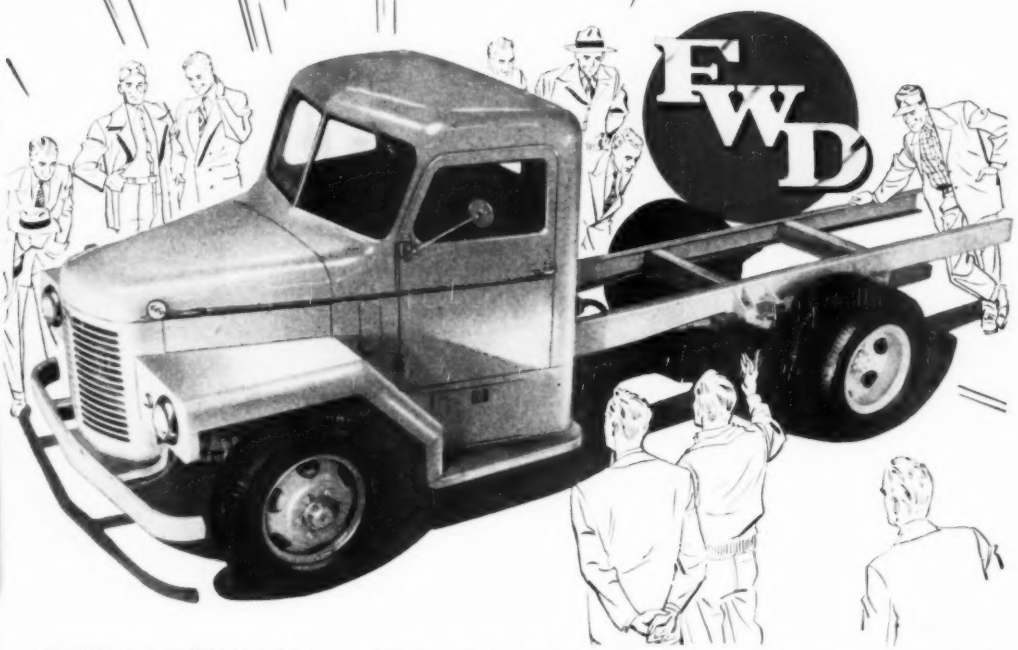
The Benefits of Competitive Efficiency:

LOW PROFIT PER UNIT—THE MOST FOR YOUR PETROLEUM DOLLAR!

SOCONY-VACUUM

SOCONY-VACUUM OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

Here's how the LD fills the bill for a LIGHT-DUTY FOUR WHEEL DRIVE



14,500 lbs. Gross Vehicle Weight

At last there is a *true* four-wheel-drive for the largest segment of the over-all truck field! The LD, born from FWD's unmatched experience in four-wheel-drive development, answers a great demand.

A *True* Four-Wheel-Drive Does *This!*

The only way to gain safety, economy and widened operation with a four-wheel-drive is to have proper distribution of load and power. FWD, alone, delivers those major advantages for this work-range.

The LD Has a *True* Truck Engine!

Only a *real* truck engine can give you peak efficiency for all the work demanding the LD. This efficiency creates on-the-job advantages, longer engine life and attractive savings in gas and oil.

Created for an Entirely New FWD work-range

One of the most important developments in 40 years of FWD leadership! Here is a completely new four-wheel-drive . . . designed to broaden the range of operation in the light-duty truck field. Now you can have a *true* four-wheel-drive to completely fill the needs which *conversions* and conventional trucks have sought to answer. This new model—the LD—fulfills countless requests for an FWD in that broad field.

GET ALL THE FACTS
on the LD! Ask for this folder, "The Story of the LD". See your FWD distributor or write FWD.

THE FOUR WHEEL DRIVE AUTO CO.
Clintonville, Wisconsin
Canadian Factory: Kitchener, Ont.
World-Wide Sales and Service

Built by the Makers of America's Foremost Heavy-Duty Trucks

How to get a fire-extinguishing system FREE!

An auto manufacturer had a mean fire hazard in some automatic screw machines.

The job called for a light oil coolant. With its low flash point the oil frequently caught fire from heat generated by machining.

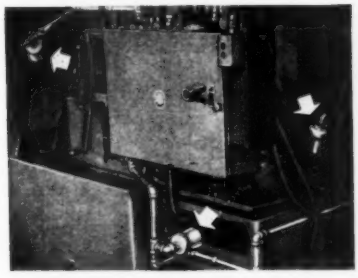
The extinguishers used by the company killed these repeated fires successfully. But the extinguisher chemical spoiled the coolant—left a mess on the machine. And downtime needed to clean the machine and replace oil after a fire was never less than 16 hours—often ran to 2 or 3 days.

Kidde extinguishing systems were installed on all these screw machines. They detect and kill fires automatically. The dry clean CO_2 discharged by the *Kidde* systems doesn't mess up the machine. It evaporates from the coolant oil, leaving no trace. After a fire, *downtime is 1 hour, no oil need be replaced.*

The *Kidde* systems cost $800 per machine. *The company says they paid for themselves in the first month!*

That's how our friends, the auto manufacturers, figure they got the *Kidde* installation free. You'd figure that way, too, wouldn't you?

If you want to know more about *how* such systems work, mail the coupon for literature.



Arrows show location of *Kidde* Multijet Nozzles through which CO_2 is discharged to kill fires starting on automatic screw machine during cutting operations. The CO_2 does the job fast—and clean.

Kidde

Walter Kidde & Company, Inc., 354 Main Street, Belleville 9, N. J.
In Canada: Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

Walter Kidde & Company, Inc.
354 Main Street, Belleville 9, N. J.

Gentlemen: Please send me descriptive literature on *Kidde* automatic extinguishing systems.

NAME.....

COMPANY.....

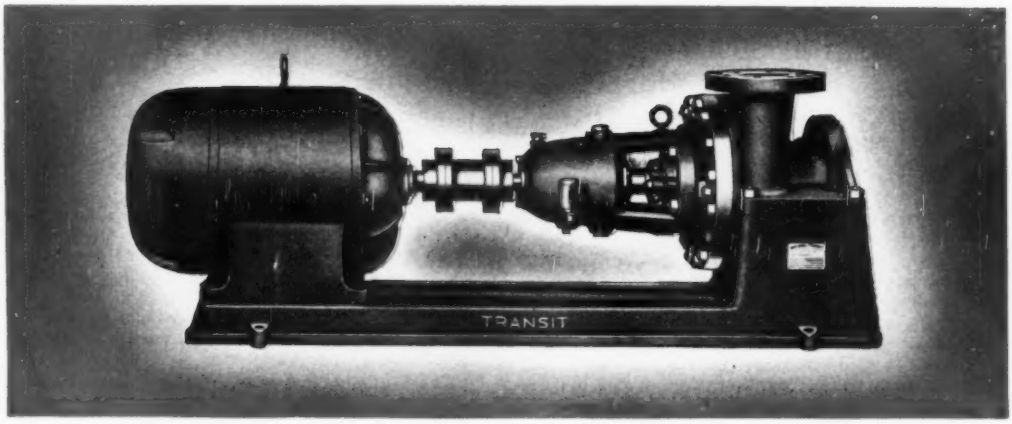
ADDRESS.....

CITY.....STATE.....

TRANSIT TYPE *ES* PROCESS CENTRIFUGALS

New 3 YEARS AGO - *Leading* TO-DAY

In toughest Refinery Services up to 900°F and 500 psi suction pressures.
82% of the original buyers have now placed additional orders.



Because they feature:

Lowest NPSH required with Impeller eye areas 15% larger and streamlined eye entrance.
Extra corrosion allowance and **smoother operation** with 3/16" greater case thickness.
Flatter performance curve for maximum operating efficiency over the capacity range.
Broadest range of head and capacity with the **highest interchangeability of parts.**
Latest developments in Mechanical Seal Design for higher dependability and simplicity.
Smoother running due to streamlining of impeller and volute and heavier bearing bracket.
Lowest maintenance. Parts subject to wear can be replaced in less time than in similar pumps.
Very latest proven design features of streamlined flow and mechanics which give greater dependability, lower maintenance and efficient operation at no higher cost.

Ask for Bulletin 6000.

For lower pressures, capacities and temperatures, ask for Bulletin 6100, Transit Type CS.

NATIONAL TRANSIT PUMP AND MACHINE CO.

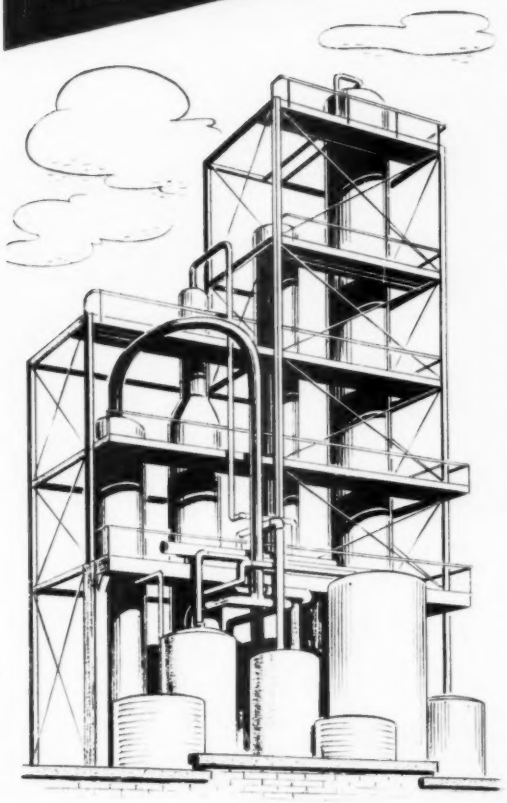
Home Office and Works, OIL CITY, PENNA.

CHICAGO, 624 South Michigan Ave. • CLEVELAND, 702 Marshall Building • HOUSTON, Room 522 West Building • NEW YORK, 30 Rockefeller Plaza • PHILADELPHIA, 2324 Fidelity Phila Trust Building

FURFURAL SOLVENT REFINING MEANS SAFE OPERATIONS

QO FURAN CHEMICALS ®

Here Is Information About Furfural Itself, Which Will Tell You Why.



HANDLING

Furfural is a liquid at room temperature and its boiling point of 323° F. removes it from the class of substances which must be handled and stored under pressure. It is unlikely that appreciable concentrations will be built up in the air.

EXPLOSIVE HAZARD

Furfural has a flash point (open cup) of 135° F. and consequently introduces no problem in the way of extreme explosive hazard.

FREEZING

The freezing point of furfural is —34° F. so even in severe weather, there is virtually no chance of freeze up in lines or tanks.

TOXICITY

Sixteen years experience in refineries throughout the world and twenty-five years of industrial experience in other processes demonstrate conclusively that furfural can be handled safely insofar as possible hazards to personnel are concerned.

SUPPLY

In addition to the safety factors mentioned above, furfural is "safe" in the sense that it is readily available in the quantities you need. Even during the war, no refinery had to cease operation for lack of furfural. It is made from an unfailing source, the non-food portion of agricultural products, such as corn cobs. Nature creates an abundant new supply of raw material each year.

LITERATURE AVAILABLE

Bulletin 203 entitled "Physical Data on Furfural" contains comprehensive data, tables and curves on the physical characteristics of furfural. Bulletin 204 "Current Uses of Furfural" tells about various uses for furfural as a selective solvent, chemical intermediate, wettant and dispersant. Send your request to the nearest office below on your company letterhead.

QO CHEMICALS

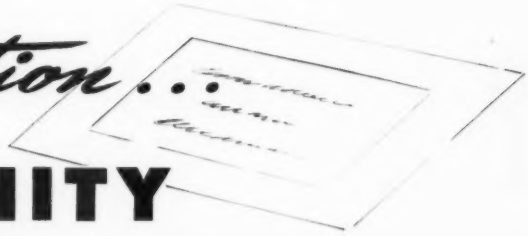
The Quaker Oats Company CHEMICALS DEPT.

1840A BOARD OF TRADE BLDG.
141 W. JACKSON BLVD., CHICAGO 4, ILLINOIS

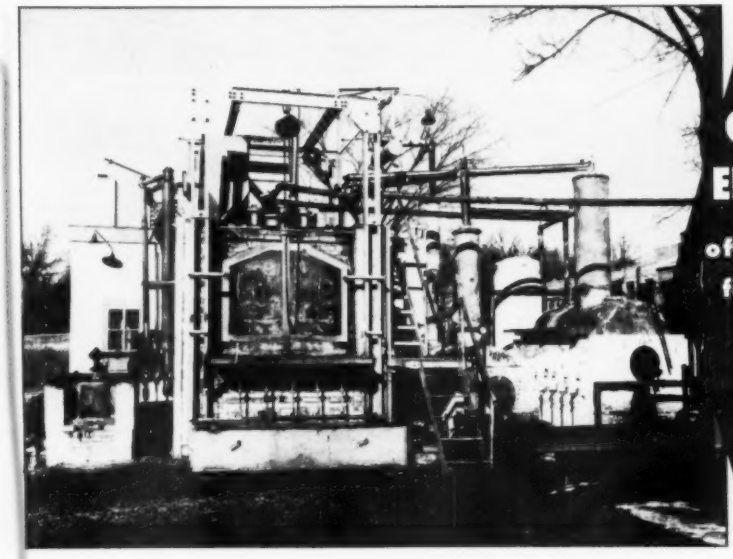
EASTERN SALES OFFICE, 1236A WHITEHALL BLDG., NEW YORK 4, N. Y.

In San Francisco, The Griffin Chemical Company In the United Kingdom, Imperial Chemical Industries Ltd., Billingham, England In Australia, Swift & Company, Pty. Ltd., Sydney
In Europe Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands; Quaker Oats (France) S. A. 42, Rue Pasquier, Paris 8E, France

An Invitation . . .
and an . . .
OPPORTUNITY



To every organization interested in disposing of its heavy residues in the broad, highly profitable Metallurgical Coke market.



CURRAN CARBONIZING & ENGINEERING CO.

offers the improved facilities of its Liquid Hydro-Carbon Coking plant (pilot) for commercial scale tests of your material.

The Curran Carbonizing Process, a flexible and economical method of high temperature coking, opens the door to the conversion of residuums to high quality METALLURGICAL COKE OR ELECTRODE CARBON.

A test of your material may well prove to be the key to greater profits for you. The assistance of Curran Coking Specialists is at your disposal in solving your coking problem (at actual cost of test to us).

Send Sample Today

(Minimum 3 bbls. requested for preliminary analysis). Larger sample required for full scale, commercial demonstration. Your representatives welcome during the course of the test. Wire, write or phone.

Curran Carbonizing & Engineering Co.

314 N. BROADWAY • CEntral 8972 • ST. LOUIS 1, MO.

HERE'S MOTOR REPAIR SERVICE

THAT WILL SAVE YOU MONEY!

A-C Certified Service Shops, like Cincinnati Electric Equipment Company shown, have modern equipment and expert personnel for fast emergency service . . . for routine maintenance and repair that keeps your production rolling smoothly.

WHEREVER YOU ARE, there is a nearby Allis-Chalmers Certified Service Shop to keep your motors and other electrical equipment running smoothly. These independent shops are selected after careful investigation for their up-to-date equipment, experienced personnel, good business practices and will to serve. They use only factory-approved parts and methods.

When you need repairs or maintenance on motors and other electrical equipment, depend on Allis-Chalmers Certified Service. Write for a list of the Certified Service Shops near you.

For New Motors and Control . . .

No one knows more about correct motor and starter application than your A-C Certified Service Shop. When you need new motors or starters, check with the one in your area or with your nearest A-C Sales Office.

ALLIS-CHALMERS, 1059A SO. 70 ST. A-2935
MILWAUKEE, WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices, throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

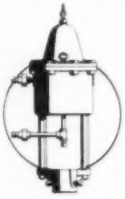
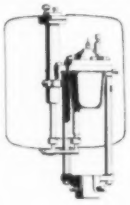
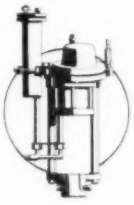
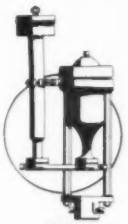
PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

What's worth metering is worth metering right!

. . . and Foxboro offers the *right* meter for every refinery measurement. See the typical applications below.

For Metering Steam to Stripper on a Stabilizing Unit	For Metering Air from a Blower	For Metering Reflux to Debutanizer in Light Ends Unit	For Metering Gas Oil to Storage in a Crude Unit	For Metering Charge to Reactor in a Poly Unit
				
TYPES 1 & 2 Meter Body light weight & low cost for indicators & portable recorders	**TYPE 9 Meter Body** for differential ranges as low as 1" H_2O — especially for low pressure gas and air service	**TYPE 17 Meter Body** unequalled quality meter for general refinery service	**TYPE 8 Meter Body** longest float travel, greatest power, highest accuracy meter ever built	**TYPE 6 Meter Body** leakproof measurement at really high pressures without compromise in accuracy

a flow meter type for every need

From its complete line of flow meters, Foxboro can offer *the best type* for virtually any metering problem . . . best in point of accuracy, dependability, and economy. There's a differential pressure range and static pressure rating to meet every requirement. Meters are available as indicators, recorders, controllers, and transmitters.

The widest selection of flow instruments is only one of many factors responsible for Foxboro's acknowledged leadership in flow metering. See how this factor — together with many superior, exclusive design features — give you most value for your money in flow metering. Write for Bulletin 351-2. **The Foxboro Company, 60 Neponset Avenue, Foxboro, Mass., U. S. A.**

Specifications of Foxboro Meter Types Illustrated

TYPE	MATERIAL	MAX. W. P.	RANGES
2	Forged Steel	1000	100"–200"
9	Cast Iron	150	2½"–10"
17	Forged Steel	1800	10"–400"
8	Forged Steel	1500	50"–400"
6	Forged Steel	3500	100"–200"

FOXBORO REG. U. S. PAT. OFF. **FLOW METERS**

On or off the road

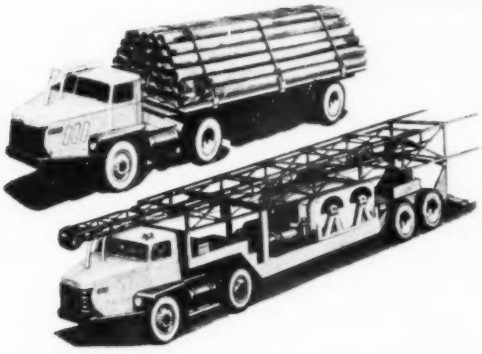
— you get there *fast* and *unfailingly* with

WALTER TRACTOR TRUCKS

— the only trucks with 100% TRACTION

Walter Tractor Trucks pull steadily through conditions that stop other trucks—sand, mud, soft dirt, snow, steep grades. Every horsepower is converted into tremendous haulpower by the exclusive Walter Four Point Positive Drive, which provides 100% traction in four driving wheels. No wheel slipping or spinning, no stalling of loads.

LOW COST HAULING of Rigs, Pipe and Heavy Equipment



With big, powerful, rugged Walter Tractor Trucks, you haul bigger loads—require fewer trucks and trips—avoid delays and stalled loads in bad running conditions. This all-weather hauling ability, plus faster running time, cuts down unproductive time for equipment and crews. Proper weight distribution permits hauling within 18,000 lbs. per axle loading limits on the highway. Gasoline, diesel or butane engines, 240, 260 and 300 hp. Hydraulic power steering and air brakes provide easy, safe handling.

NEW! High-speed, high capacity *WALTER FIRE FIGHTER*

This giant 42,000 lb. Walter Fire Fighter gets to any fire fast, no matter how severe the weather or running conditions. Quickly smothers oil or gasoline fires in a tremendous blanket of fire-sealing Fog-Foam. Discharges a total of 4,800 gal. of fog-foam per minute. Completely self-contained, ready for instant action. Accelerates to 45 mph. in one minute.

WALTER 4-POINT POSITIVE DRIVE
TRACTOR TRUCKS

Write for full information on these units.

WALTER MOTOR TRUCK CO.

1001-19 Irving Ave., Ridgewood 27, Queens, L. I., N. Y.

PFI STANDARDS for Better Piping Include Piping Requirements of these codes

"STANDARDIZATION Assures Quality and Promotes Economy"

The standards for uniform pipe fabricating practices being published by the PFI take into account the requirements of the above Codes in-so-far as they apply to piping. Pipe fabrication in accordance with PFI Standards will comply with these Codes.

In the PFI Standards, these Codes are interpreted correctly by engineers of long experience in piping. Economic factors are given equal consideration with technical and manufacturing questions.

PFI Standards, used by all qualified pipe fabricators, assure the customer of better piping and maximum dollar value. The designing engineer will find that they save time for him . . . also save time in materials procurement and in erection.

If you are interested in having (without charge) the four PFI Standards already published and receiving the additional Standards as they are issued, address your request to—

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING, PITTSBURGH 22, PA.

4152

GROVE

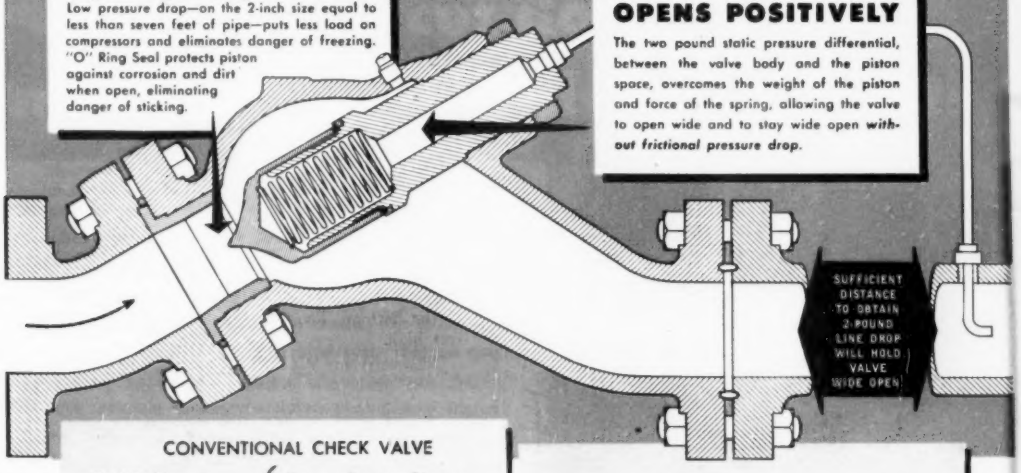
FULLSTREAM WIDE OPEN CHECK VALVE

WIDE OPEN FLOW

No turbulence because of the Grove Fullstream design with only 30° change in flow direction. Low pressure drop—on the 2-inch size equal to less than seven feet of pipe—puts less load on compressors and eliminates danger of freezing. "O" Ring Seal protects piston against corrosion and dirt when open, eliminating danger of sticking.

OPENS POSITIVELY

The two pound static pressure differential, between the valve body and the piston space, overcomes the weight of the piston and force of the spring, allowing the valve to open wide and to stay wide open *without frictional pressure drop.*



CONVENTIONAL CHECK VALVE

Total Resistance to Flow, for example, 2-inch size

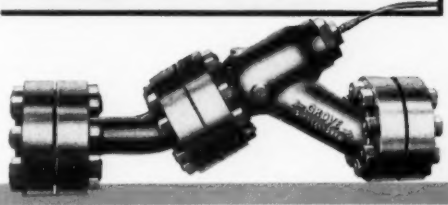
Pressure drop equal to over 50-feet of pipe
Force of spring to overcome
Weight of moving parts to lift
Friction of guides, piston rings, etc., to overcome

GROVE FULLSTREAM CHECK VALVE

Total Resistance to Flow, for example, 2-inch size

Pressure drop of less than 7-feet of pipe
No force of spring to overcome
No weight of piston to overcome

Compare the resistance to flow of the Grove Fullstream Valve with the conventional check valve in the chart above. Because of the two pound static pressure differential, caused by the line pressure drop between the valve and the control point, there is no frictional pressure loss from lifting the valve piston or overcoming the force of the spring. The Wide Open design creates no turbulence. Pressure drop on the 2-inch size is equal to less than seven feet of pipe. Low pressure drop eliminates freezing. Protected valve parts insure opening and closing by eliminating sticking due to corrosion, dirt, waxing, etc. Reduce your compressor load by reducing pressure loss with the Grove Fullstream Wide Open Check Valve. Write or wire today for a Grove engineer to tell the full story of this amazing check valve.



THE OUTSTANDING GROVE FULLSTREAM VALVE

WIDE OPEN GROVE DESIGN means no turbulence. LOW PRESSURE DROP—in the 2-inch size less pressure drop than conventional 3-inch size—means less compressor load. POSITIVE OPENING assured because of the 2-pound static pressure differential. POSITIVE CLOSING because the "O" Ring seals piston against damage by dirt and corrosion, preventing sticking and waxing. FULL RANGE OF SIZES for all pressure ranges.

GROVE REGULATOR COMPANY

3608 NAVIGATION BLVD., HOUSTON, TEXAS
6529 HOLLIS ST., OAKLAND, CALIF.
1930 W. OLYMPIC BLVD., LOS ANGELES, CALIF.

Built by GRAVER

Regenerator-reactor unit and stripper . . . main catalyst storage hopper . . . auxiliary catalyst storage hopper for new cat cracker of Wood River Oil & Refining Co., Inc., Hartford, Ill.

Congratulations

WOOD RIVER on the new fluid catalytic cracking unit now on stream, making high octane cat-cracked gasoline. Graver is proud of its part in the completion of this 7500-barrel-per-day unit, designed and licensed by Universal Oil Products Company.

Graver fabricated and erected the reactor and regenerator column and two large catalyst storage hoppers. The reactor is 13′ 6″ inside diameter and the regenerator is 19′ 8″ inside diameter at the bottom. The entire unit stands about 150 feet high.

This work for WOOD RIVER again identifies Graver with new refining plants and prompts investigation by refiners who are planning new catalytic cracking units.

GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

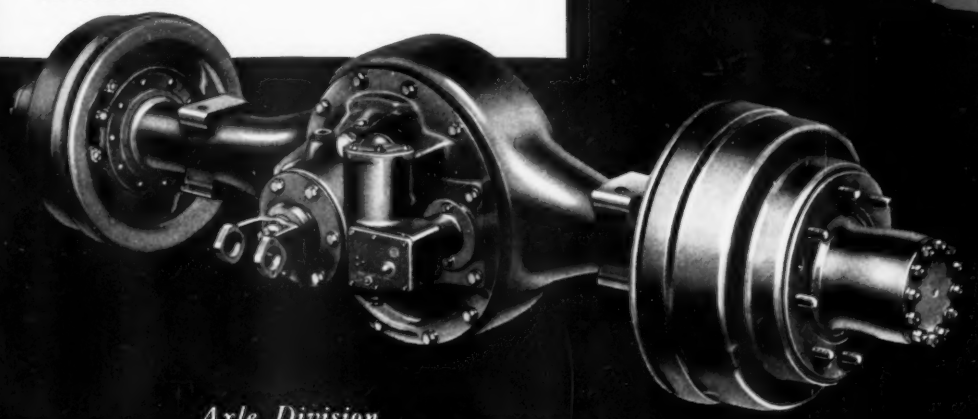
NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

EATON

2-Speed Truck

AXLES cut down Stress and Wear on Vital Truck Parts

Eaton 2-Speed Axles *double* the conventional number of gear ratios, enabling drivers to use the *right* gear ratio for every operating condition—starting out under full load, climbing grades, highballing, quick shifting in traffic. As a result, vital truck parts are not overstressed, engines are permitted to run at most efficient speeds, minimizing engine wear. Furthermore, Eaton Axles last longer, because planetary gearing better distributes gear-tooth loads, reducing stress and wear on the axle itself. Ask your truck dealer to explain how Eaton 2-Speed Axles more than pay for themselves.



Axle Division

EATON MANUFACTURING COMPANY

CLEVELAND, OHIO

PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS

HUDSON DIRECTAIRE UNITS

Hudson DIRECTAIRE units are now transferring more than 500,000,000 BTU per hour of process heat from steam, gas, jacket water, hot oil and hydrocarbon vapors DIRECTLY TO THE AIR, obviating the use of water as an intermediate transfer medium. Gears, driveshafts, fans, finned tube surface and structural steel supporting frame work which make up the Hudson DIRECTAIRE units are selected and designed for long life in continuous outdoor service. Drivers may be electric motors, steam turbines, gas engines, or hydraulic motors. DIRECTAIRE units are manufactured and assembled in the recently completed Hudson plant at Houston. The Hudson organization welcomes the opportunity of studying your overall heat dissipation problem. Such studies will enable you to make the most advantageous selections of cooling equipment for the particular problem, whether Cooling Towers with water cooled units; or DIRECTAIRE units, or combinations of the two.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION HOUSTON, TEXAS

BATTERY OF TWELVE HUDSON *DIRECTAIRE* UNITS
COOLING HOT OIL AND GAS AND CONDENSING STEAM AND
HYDROCARBON VAPORS IN A TEXAS GAS PROCESSING PLANT

Designers and Constructors of { GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

CUT YOUR BILLS

for corrosion-resistant pipe UP to 50%

FREE BOOKLET...

gives you the complete story on Alcoa Aluminum Pipe—physical and mechanical properties; lists products for which it may be used. Write today.

For Alcoa Aluminum Pipe and other Alcoa Products Consult your Classified Telephone Directory under the heading "Aluminum".

You can save up to fifty per cent on corrosion-resistant pipe when you specify Alcoa Aluminum 63S Pipe. Highly resistant to attack by sulfur compounds—safely carries many chemicals, petroleum products, foods, commodities. The products won't hurt the pipe, and the pipe won't hurt the products.

Alcoa Pipe costs far less per foot than other corrosion-resistant metal pipe. Goes in faster, too, because it weighs only one-third as much as other metal pipe. Can be easily joined by familiar methods and with standard fittings and flanges available from several nationally known manufacturers.

Alcoa Aluminum Pipe is seamless and is available in ⅛" to 12" standard pipe sizes. For your nearest supplier, phone your local Alcoa sales office (branches in 55 cities) or write ALUMINUM COMPANY OF AMERICA, 1978C Gulf Building, Pittsburgh 19, Pennsylvania.

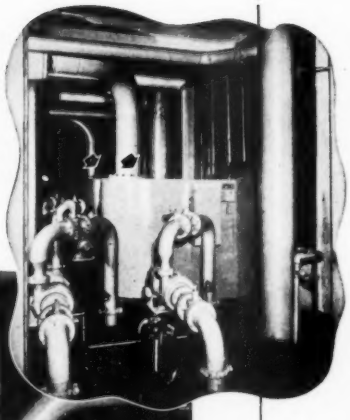
ALCOA ALUMINUM PIPE

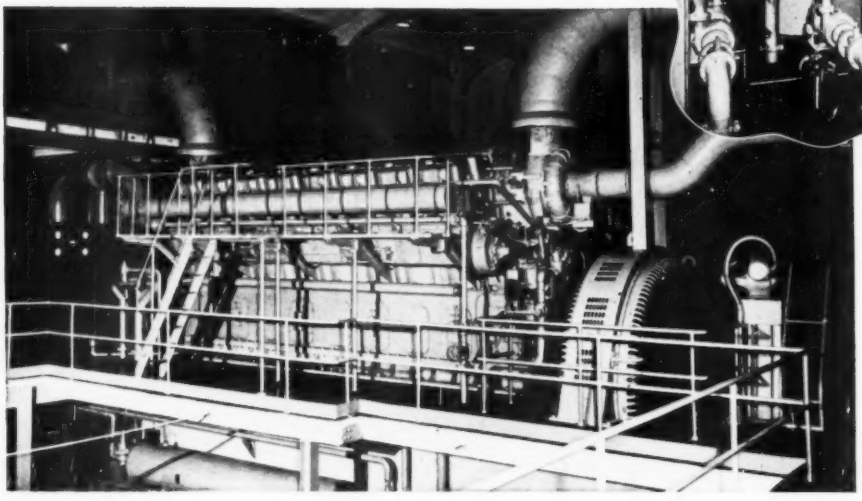
ALCOA ALUMINUM

INGOT • SHEET & PLATE • SHAPES, ROLLED & EXTRUDED • WIRE • ROD • BAR • TUBING • PIPE • SAND, DIE & PERMANENT MOLD CASTINGS • FORGINGS • IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS • SCREW MACHINE PRODUCTS • FABRICATED PRODUCTS • FASTENERS • FOIL • ALUMINUM PIGMENTS • MAGNESIUM PRODUCTS

IT'S NEW! IT'S BIG!

It's protected by AAF Filters!





FIRST 16 CYLINDER COOPER-BESSEMER GAS DIESEL ENGINE IS EQUIPPED WITH MULTI-DUTY FILTERS.

COOPER-BESSEMER makes engine history again with the installation of its first 16 cylinder gas diesel unit. This 3300 HP giant is teamed up with another 1650 HP, 8 cylinder Cooper-Bessemer engine at Arizona Edison's Yuma, Arizona gas diesel plant.

Realizing the importance of clean air to engine health, this manufacturer took no chances —equipped both engines with AAF Type CMS Multi-Duty Filters. Three filters serve the large engine (two of which are pictured above), while a single Multi-Duty Filter stands guard at the air intake of the smaller unit.

The Type CMS Multi-Duty is both automatic and self-cleaning. An overlapping screen panel curtain assures both the delivery of a uniform air volume and a positive self-cleaning action. When once established for a given dust concentration, operating resistance remains fixed. Except for periodic inspection and removal of sludge at regular intervals, operation of unit is entirely automatic.

You can't compromise with dust and dirt with a major investment at stake. AAF Multi-Duty Filters are today protecting engines and compressors valued at millions. Write today for Bulletin No. 150.

AMERICAN AIR FILTER COMPANY, INC.
444 Central Avenue, Louisville 8, Kentucky
In Canada: Darling Bros., Ltd., Montreal, P. Q.

AAF

AIR FILTERS
AND DUST CONTROL EQUIPMENT

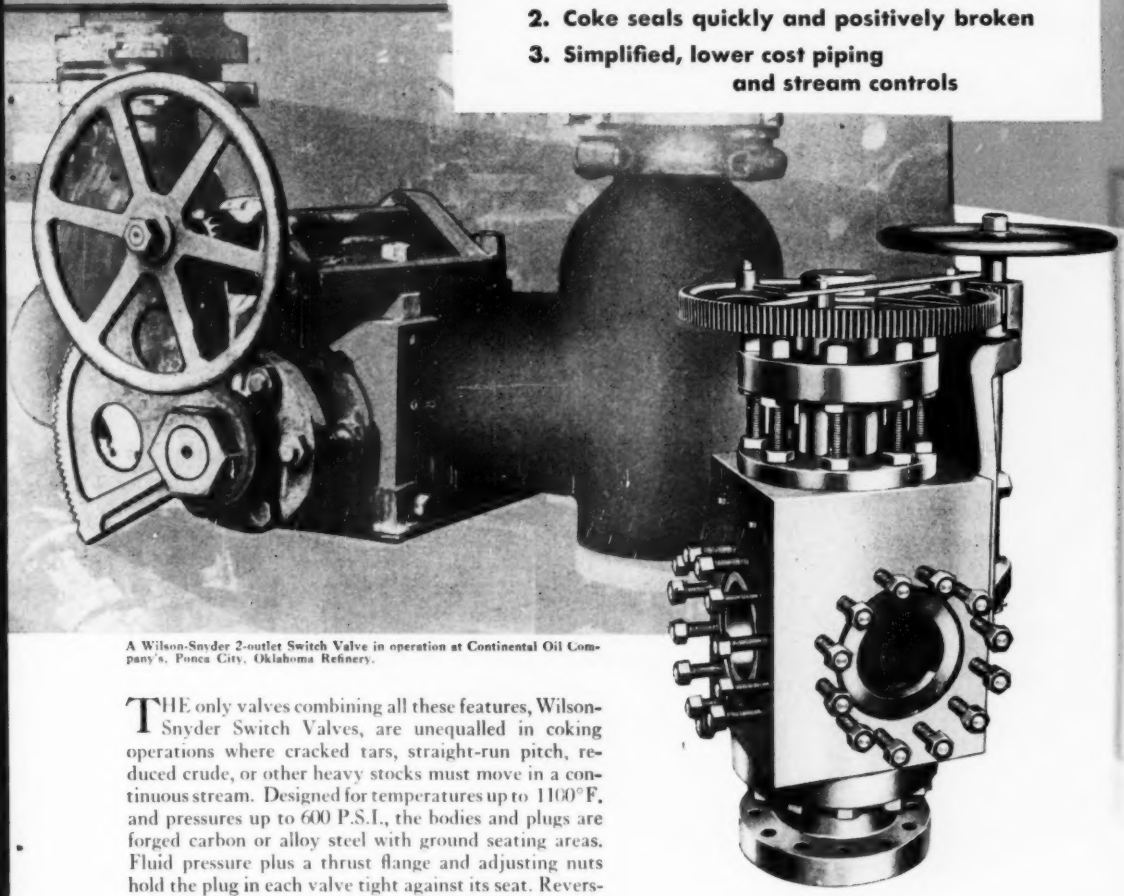
PLANNING ON RUNNING TO COKE?

Then you'll want

WILSON-SNYDER SWITCH VALVES

to insure:

1. Uninterrupted flow when switching
2. Coke seals quickly and positively broken
3. Simplified, lower cost piping and stream controls



A Wilson-Snyder 2-outlet Switch Valve in operation at Continental Oil Company's, Ponca City, Oklahoma Refinery.

THE only valves combining all these features, Wilson-Snyder Switch Valves, are unequalled in coking operations where cracked tars, straight-run pitch, reduced crude, or other heavy stocks must move in a continuous stream. Designed for temperatures up to 1100°F. and pressures up to 600 P.S.I., the bodies and plugs are forged carbon or alloy steel with ground seating areas. Fluid pressure plus a thrust flange and adjusting nuts hold the plug in each valve tight against its seat. Reversing nut pressure on this flange quickly breaks the coke seal.

Wilson-Snyder Switch Valves are available in sizes from 2" to 10" with single inlet and two, three, or four outlets, or the reverse. Connections to suit your requirements can be furnished in any case.

Your local "Oilwell" representative will gladly give you complete information on Wilson-Snyder Switch Valves and pumps for all refinery applications.

Close-up view of a Wilson-Snyder Switch Valve ready for installation.

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

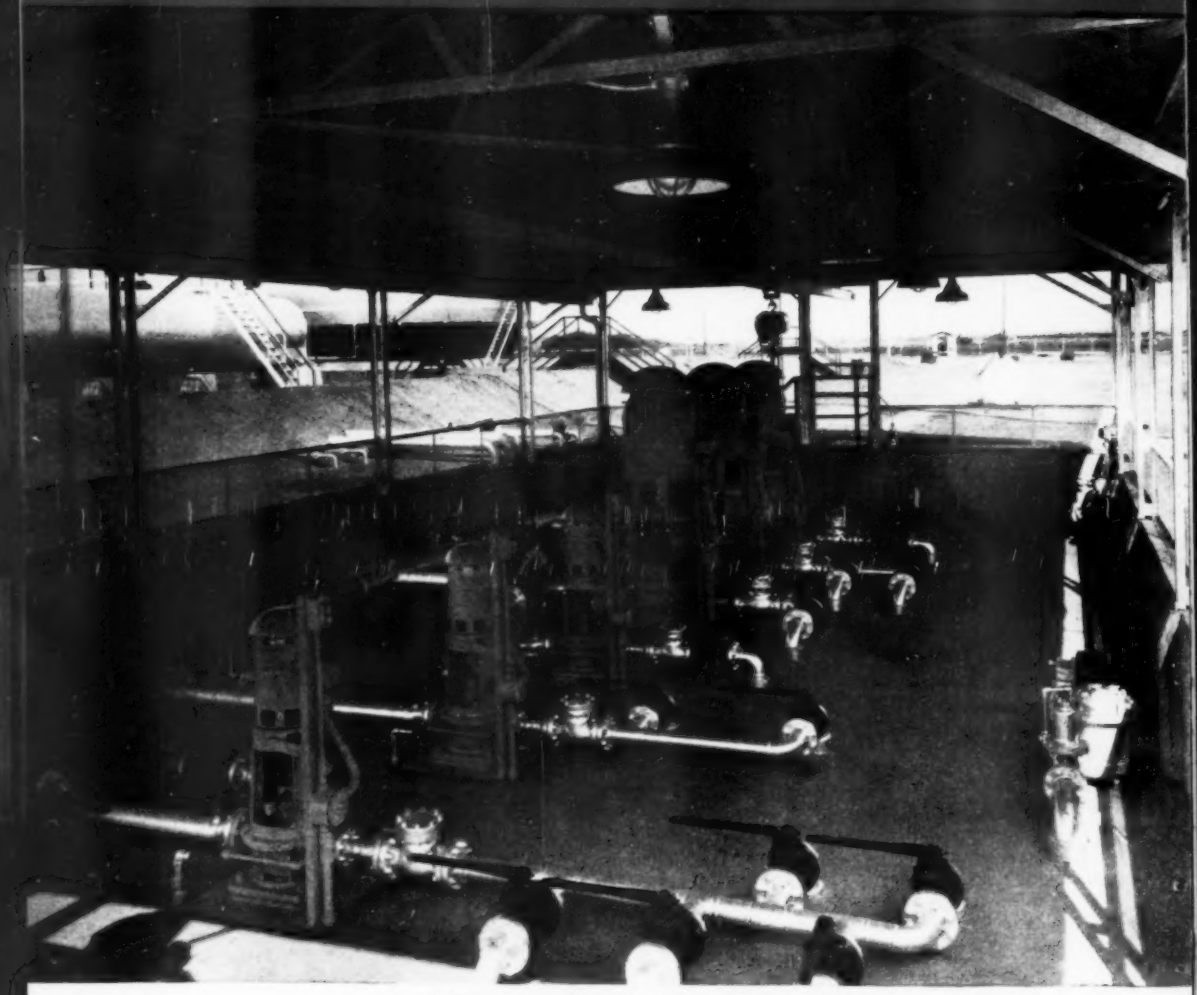
Executive Office — DALLAS, TEXAS
Export Division Office —
30 ROCKEFELLER PLAZA
NEW YORK 20, NEW YORK

Division Offices — CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

PRODUCTS HANDLING..



Nordstroms in a products pipe line pumping station.

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

TRADE MARK

PATENTS APPLIED FOR

Hypermatic lubricant makes tremendous improvement in Nordstrom valves. Being *energizable* it self-seals, self-feeds, keeping the valves in a 100% lubricated condition, for prevention of leakage and insuring most positive operation. Maintenance costs are cut to the minimum.

. . . infinitely safer with NORDSTROMS

● In handling petroleum products you first consider *safety*. That calls for ever-tight valves, free from freezing, free to turn easily, positively sealed around the ports regardless of line pressure. Note how perfectly the Nordstrom design fits these specifications. The tapered plug is pressure lubricated, held tight on its unexposed seat by resilient means; the lubricated seat permits easy rotary turning of the plug, as contrasted to metal-to-metal unlubricated seats in common types; "Sealdport" lubrication surrounds each port to prevent leakage; the plug can be hydraulically jacked when required.

For handling gasoline, distillates, butane, propane and other petroleum products, Nordstroms have no equal. They keep upkeep down.

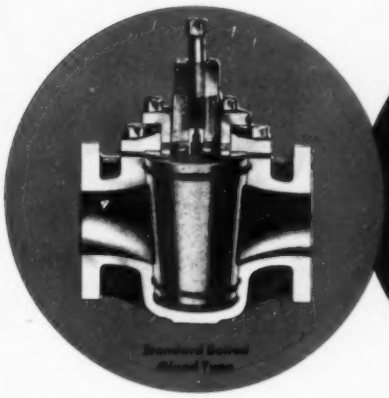
Put Nordstroms to ANY test

Install them, for test, side by side with any other type, check their operation, compare their performance . . . make a record of maintenance costs. You will find them to be tops in performance—and by far the most economical valves you have ever used. Successful operation of over 5,000,000 Nordstroms is proof of performance.

Nordstrom Valve Division—ROCKWELL MANUFACTURING COMPANY

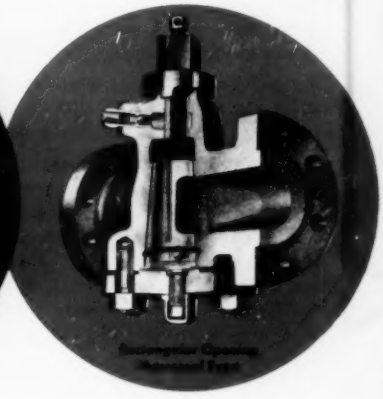
400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa
. . . and leading Supply Houses • Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Building, New York 1, N. Y.



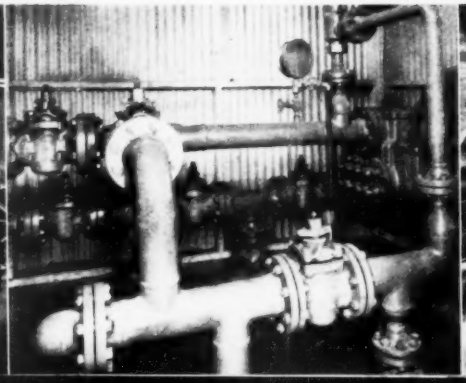
Standard Bonnet Mixed Type

Round Opening Hypreseal Type

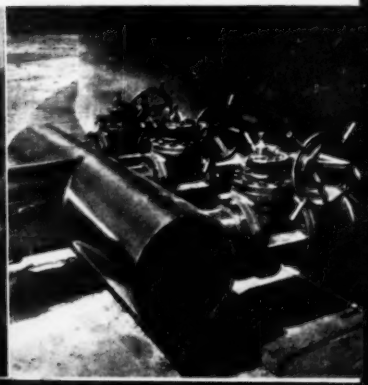


Nordstrom valves in a products pump station.

Nordstroms on products line in pump house.

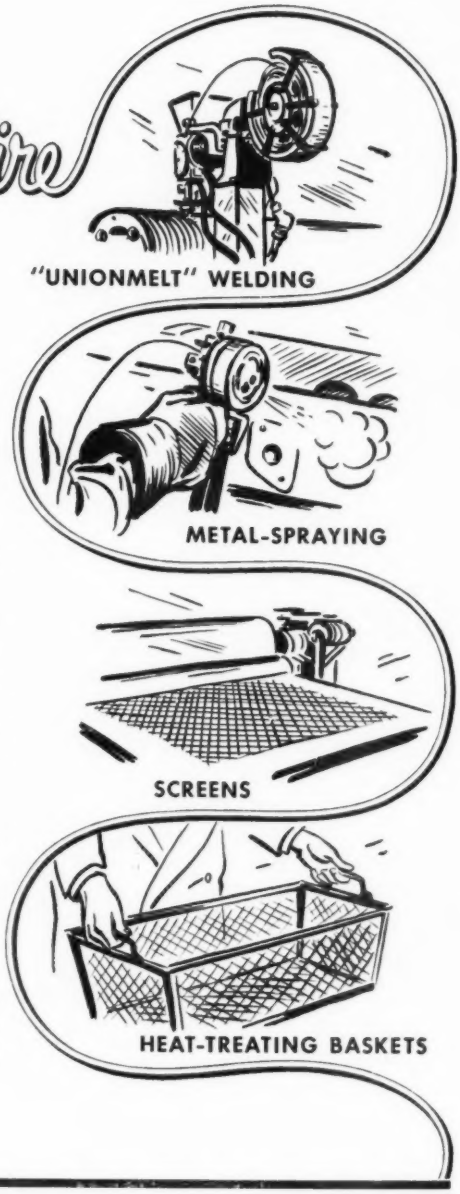


Nordstroms on connections to gasoline storage tank.



HASTELLOY *Alloy Wire*
TRADE-MARK

FOR METAL-SPRAYING, WELDING, and FABRICATED WIRE PRODUCTS



HASTELLOY nickel-base alloys, in the form of drawn wire, are available for the fabrication of corrosion-resistant screen, cloth, and baskets. The wire is also excellent for metal-spraying and for many types of automatic welding and hard-facing.

HASTELLOY alloys have a tensile strength comparable to that of the high-strength alloy steels, and possess unusual strength even at elevated temperatures. These alloys are specially designed to withstand the most severe conditions of chemical corrosion. Nickel-molybdenum alloy B is particularly resistant to hydrochloric and sulphuric acids, many organic acids, and all alkalies. Alloy C, a nickel-molybdenum-chromium-tungsten-iron composition, has excellent resistance to strong oxidizing agents, such as ferric chloride and wet chlorine, and is outstanding in its resistance to brine and salt spray.

In addition to HASTELLOY alloy wire, you can also obtain wire made of MULTIMET alloy—a cobalt-chromium-nickel composition developed for service at elevated temperatures.

Cut and straightened lengths or coils, in diameters down to 0.060 in., can be obtained directly from Haynes Stellite Company, Kokomo, Indiana. Wire in diameters less than 0.060 in. down to 0.002 in. is available from an associate company, Kemet Laboratories Company, Inc., Madison Avenue and West 117th Street, Cleveland 1, Ohio. For more complete information, write for a copy of the booklet, "HASTELLOY High-Strength, Nickel-Base, Corrosion-Resistant Alloys."

HAYNES
TRADE-MARK
Alloys

Haynes Stellite Division
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

The terms "Haynes," "Hastelloy," "Multimet," and "Unionmelt" are trade-marks of Union Carbide and Carbon Corporation or its Units.

USE THESE BETTER

Vogt Products

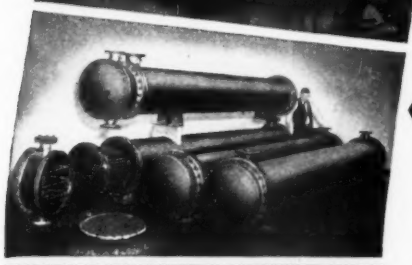
For Today's Tough Service Demands

EFFICIENT AND DEPENDABLE STEAM GENERATION

Vogt steam generating units are designed to give maximum rating in a minimum of space with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels, as desired, meet every power, heating or process requirement.

PROCESS EQUIPMENT FOR EVERY SERVICE

Stills, towers, oil chilling machines, filter presses, heat exchangers, etc. are constructed to all Codes. They meet all demands for operating security and trouble-free performance and help to lower costs in important process industries around the world.

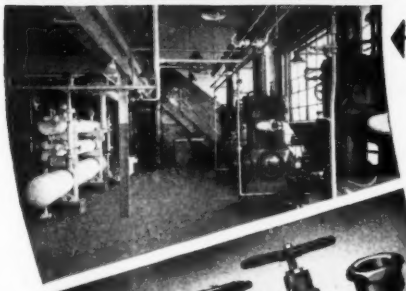


SPECIAL MATERIALS FIGHT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment made from special metals and alloys to combat corrosion, and product contamination or discoloration. Fabrication procedures employed insure that corrosion resistant properties of welds will match that of the materials from which units are constructed.

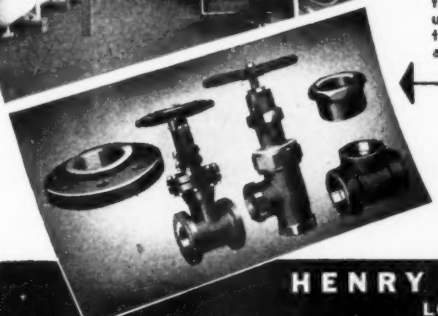
MORE TONNAGE AT LESS COST

Over 60 years of manufacturing experience, engineering and research stand behind Vogt refrigerating and ice making machinery. Absorption Systems, Compression Systems, and the Automatic Tube-Ice Machine in a wide range of capacities serve in leading petroleum refineries, chemical plants, ice and cold storage plants, dairies, packing plants, etc., at home and abroad.



DROP FORGED FOR EXTRA TOUGHNESS AND LONG-TIME SERVICE

Vogt valves, fittings and flanges, for top performance in oil, water, air, gas, and ammonia services, at high or low pressures and temperatures, are available drop forged entirely from carbon steel or stainless steel. Valves can be furnished in a combination of materials by using stainless steel for parts affected by service temperature or corrosion, and less expensive alloys or carbon steel for other parts.

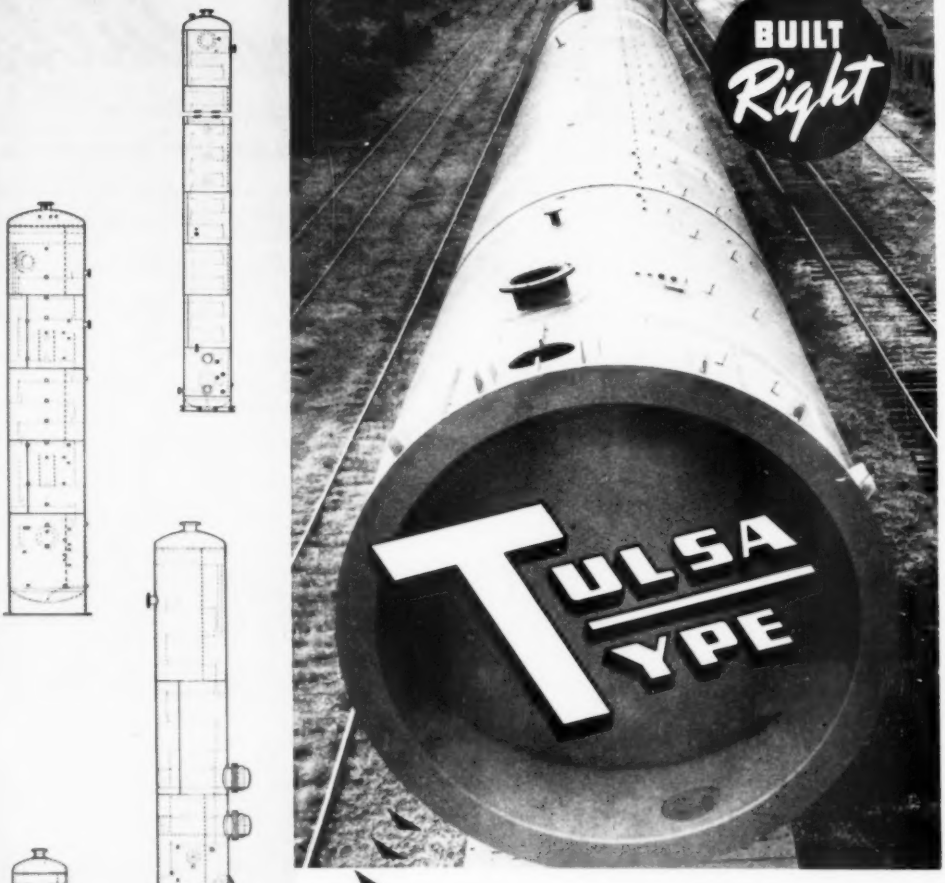


Air View of Vogt Plant

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

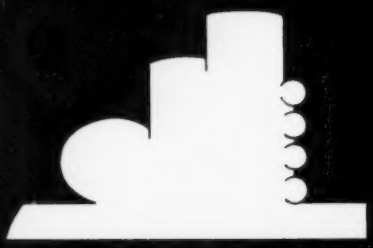


FLINT STEEL CORPORATION
TULSA, OKLAHOMA

PLATE FABRICATING_____STRUCTURAL FABRICATING
REINFORCING FABRICATING_____WAREHOUSE PRODUCTS

increased thru-put
decreased costs
higher net earnings

the "break-thru"



Many refiners planning a "break-thru" on to a higher profit level are utilizing Foster Wheeler's complete engineering and construction service for revamping older units and installing new supplementary units.

Foster Wheeler has recently completed the revamping of several direct fired heaters, a large three-stage crude distillation unit, an old continuous crude battery, and is currently revamping and modernizing the gasoline production facilities of a large refinery including the replacement of Houdry cracking cases with a 15,000 bbl/day gas-lift Thermafor catalytic cracking section.

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FW

the...complete...engineering and construction service

anywhere in the world

design patterns of all petroleum processes, —reproducible in any desired capacity.

engineering, the multi-detailed step between design and construction all coordinated by experienced planners toward one objective:—a satisfied refiner.

fabrication facilities in any or all of three FW plants move the job along faster.

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process units
petroleum refineries
chemical plants

>500

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When you use...

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"HERCULES"
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Being made in Round and Flattened Strand constructions, there is a correct type for every wire rope requirement in every industry.

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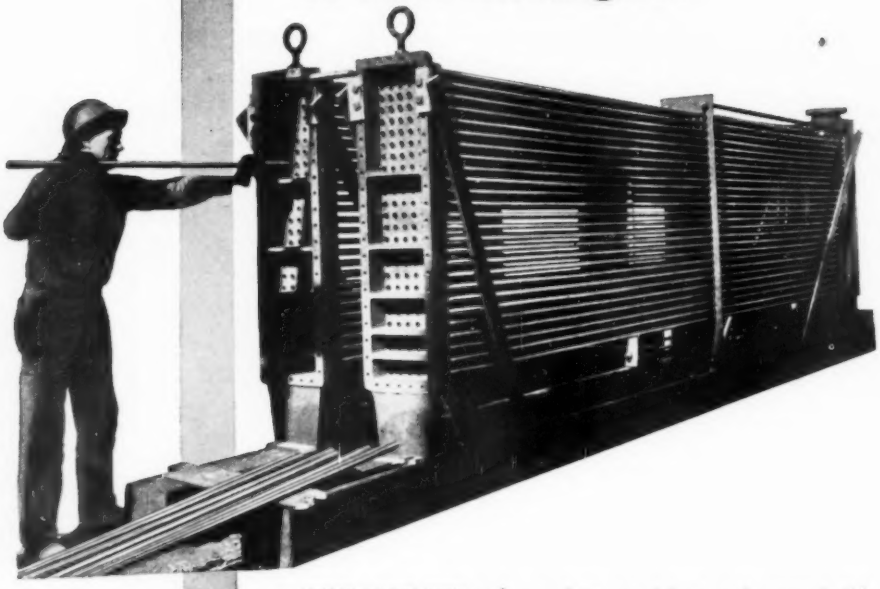
What technical service can Anaconda give you on Heat Exchangers?



ANACONDA Arsenical Admiralty Tubes being installed in tube bundle at Lemont, Illinois plant of Globe Oil & Refining Co. Fortified against dezincification by the arsenic content, tubes of this ANACONDA Alloy are being used with good results in many types of petroleum refining and other process equipment.

EVERY LARGE USER and manufacturer of heat exchangers builds up wide experience with tube and tube sheet materials. But The American Brass Company serves many such users and manufacturers, shares with each their toughest problems, makes this wider experience available to all.

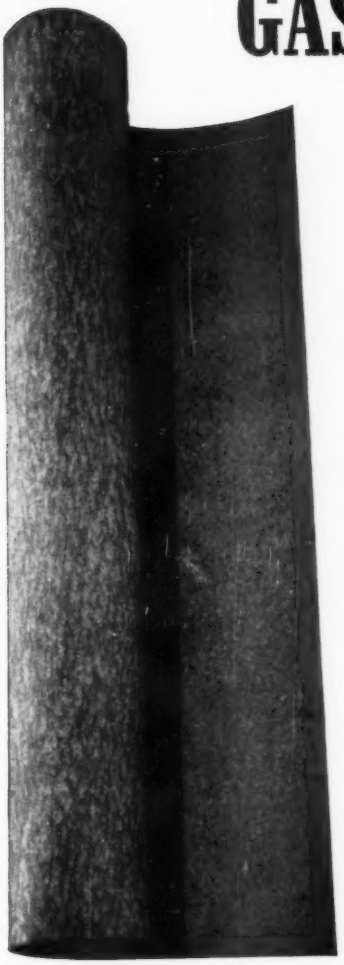
Special laboratory facilities are maintained for this work. Detailed records of problems, conditions, findings are accumulated. These data, plus the results of continuous laboratory and field tests, are used to solve new problems.

These facilities can help produce the answers to your questions—suggest materials that will give your heat exchangers more dependability, longer life, more value under specific conditions.

We hope you will work with us—let us work with you. Write for Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers." Please address The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

For efficient heat transfer ANACONDA® HEAT EXCHANGER TUBES

PROTECT AGAINST GASKET BLOW-OUTS



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The average tensile strength of this exceptional compressed asbestos gasket sheet, R/M No. 10,000, is 10,000 pounds per square inch. No other sheet packing even approaches this. It can be used wherever ordinary sheets will tear or blow out. 10,000 pounds takes a lot of tearing.

R/M No. 10,000 was developed for narrow flange gaskets serving under extreme pressure, and is recommended for heat exchangers, condensers, and high-pressure stills. The exceptional structure, quality, and tensile strength of this sheet make it the best choice for general service.

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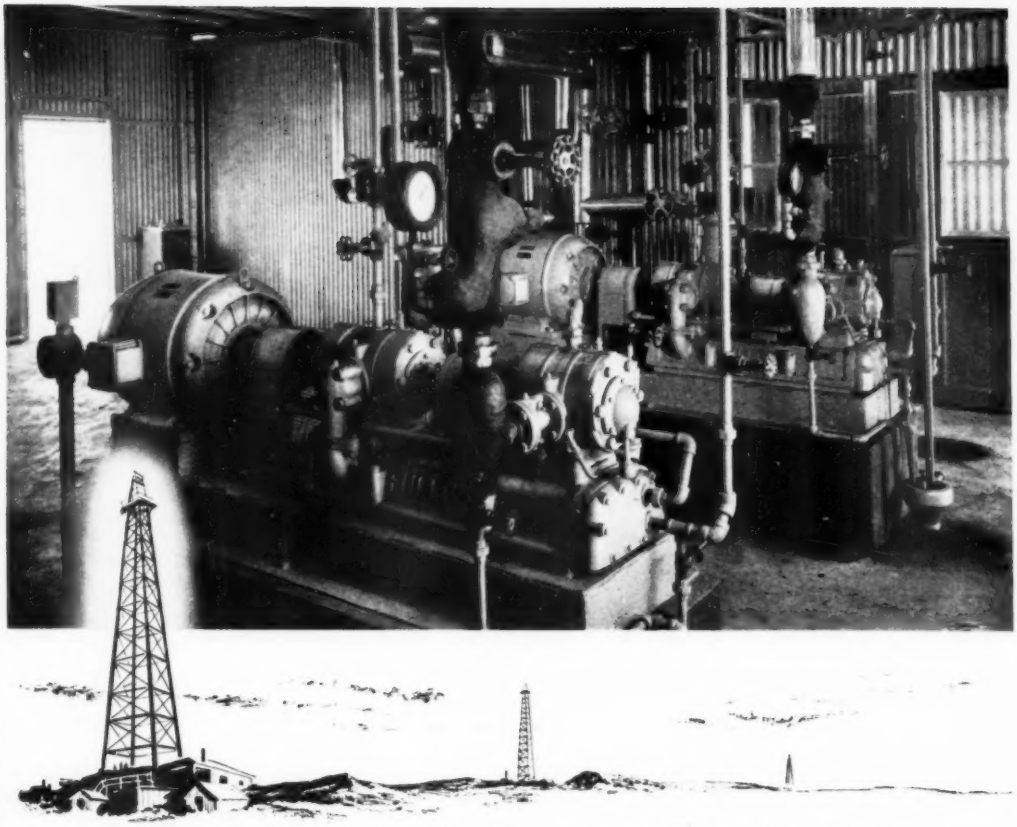

WHEN WE SAY "A FULL LIFETIME OF NEW MACHINE EFFICIENCY"

WE MEAN IT! FULLER ROTARY COMPRESSORS

Fuller has been building rotary compressors for petroleum refiners for many years. In that time, Fuller Compressors have earned a solid reputation for complete dependability under all operating conditions and in all sorts and kinds of locations.

That's because Fuller Compressors are engineered to have a full lifetime of new machine efficiency and reliability. They have a minimum of moving parts—the rotor, bearings and blades. Blades automatically compensate for wear—there are no valves to leak or seats to grind—no need for frequent inspection and servicing.

That's why Fuller Rotary Compressors are ideal for use on gathering lines where you need to boost pressure to trunk line level. You can spot them where you need them—and always be sure they'll be on the job, tirelessly and dependably. If you're interested in boosting gathering line pressure most efficiently and economically, we suggest you get in touch with a Fuller Engineer. And for your own files, why not write today for Bulletin C-5, which describes and illustrates Fuller Rotary Compressors in detail.

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Pressures to 125 psig.
Capacities to 3300 cfm.

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DRY MATERIAL CONVEYING SYSTEMS AND COOLERS
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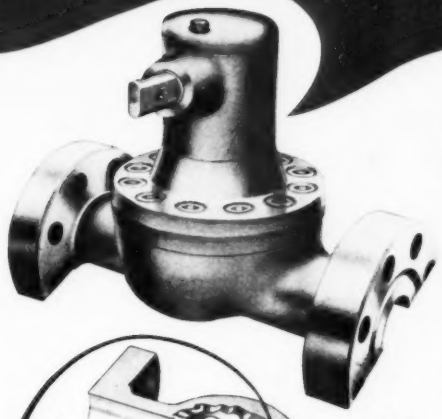
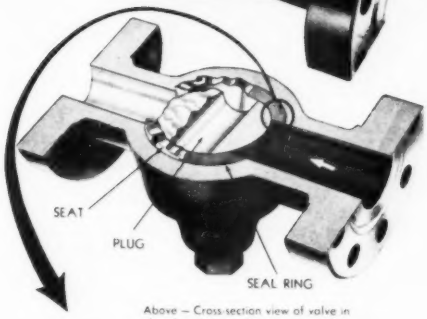
C-201

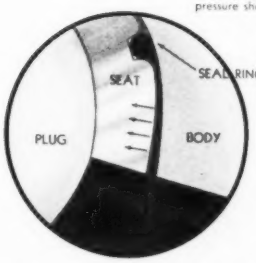
THE Cameron NON-LUBRICATED LIFT-PLUG VALVE

USES LINE PRESSURE TO MAKE A TIGHT SEAL TIGHTER





Above – Cross-section view of valve in closed position with area exposed to pressure shown in red.



Above – Enlarged section with area of seat exposed to pressure purposely exaggerated to demonstrate pressure sealing action.

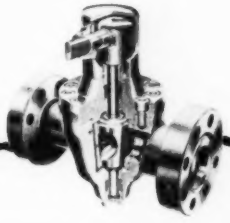
Above – Removable seat. Exterior area exposed to pressure shown in red.

It is generally agreed that body distortion will cause most conventional valves to leak due to the fact that the sealing surfaces tend to separate under the action of pressure forces and line strains. In order to bridge this separation of the sealing surfaces, a viscous lubricant is usually injected into the valve.

The Cameron "LP" Valve is non-lubricated, requiring no lubricant to maintain a seal since pressure forces act to improve rather than to destroy the seal.

Illustrated herewith is a section through a Cameron "LP" Valve in the closed position. The plug is firmly wedged into the seat during the final step of the actuator motion and a primary metal-to-metal seal is secured. Then, as shown in the circled enlargement, line pressure (indicated by red) exerts forces on an exterior portion of the seat to press it into even closer sealing contact with the plug.

As indicated in red on the seat, shown completely removed from the body, line pressure acts on an exterior surface completely surrounding the port to assure uniform deflection of the seat to maintain a seal at all points. This pressure is confined to the desired area by a seal ring which also prevents leakage between the seat and the body.



THE BEST FEATURES OF PLUG AND GATE VALVES COMBINED WITH NEW CAMERON INNOVATIONS

- NON-LUBRICATED—no grease of any kind required to effect a seal; also reduces chance for human error and need for maintenance.
- PRESSURE SEALING—when plug is seated, line pressure automatically forces seat into tighter engagement with plug.
- UNIQUE LIFT-PLUG ACTUATOR—a novel mechanical design which lifts, turns and reseats plug in continuous turn of a lever.
- RENEWABLE SEAT AND PLUG—easily replaced; permits any desired trim.
- FIELD REPAIR—can be completely overhauled without removal from line; no special tools or skill required.
- EASY OPERATION—requires less operating effort than other valve designs.
- FORGED STEEL—All parts, including body, are press or drop forged from specification materials.

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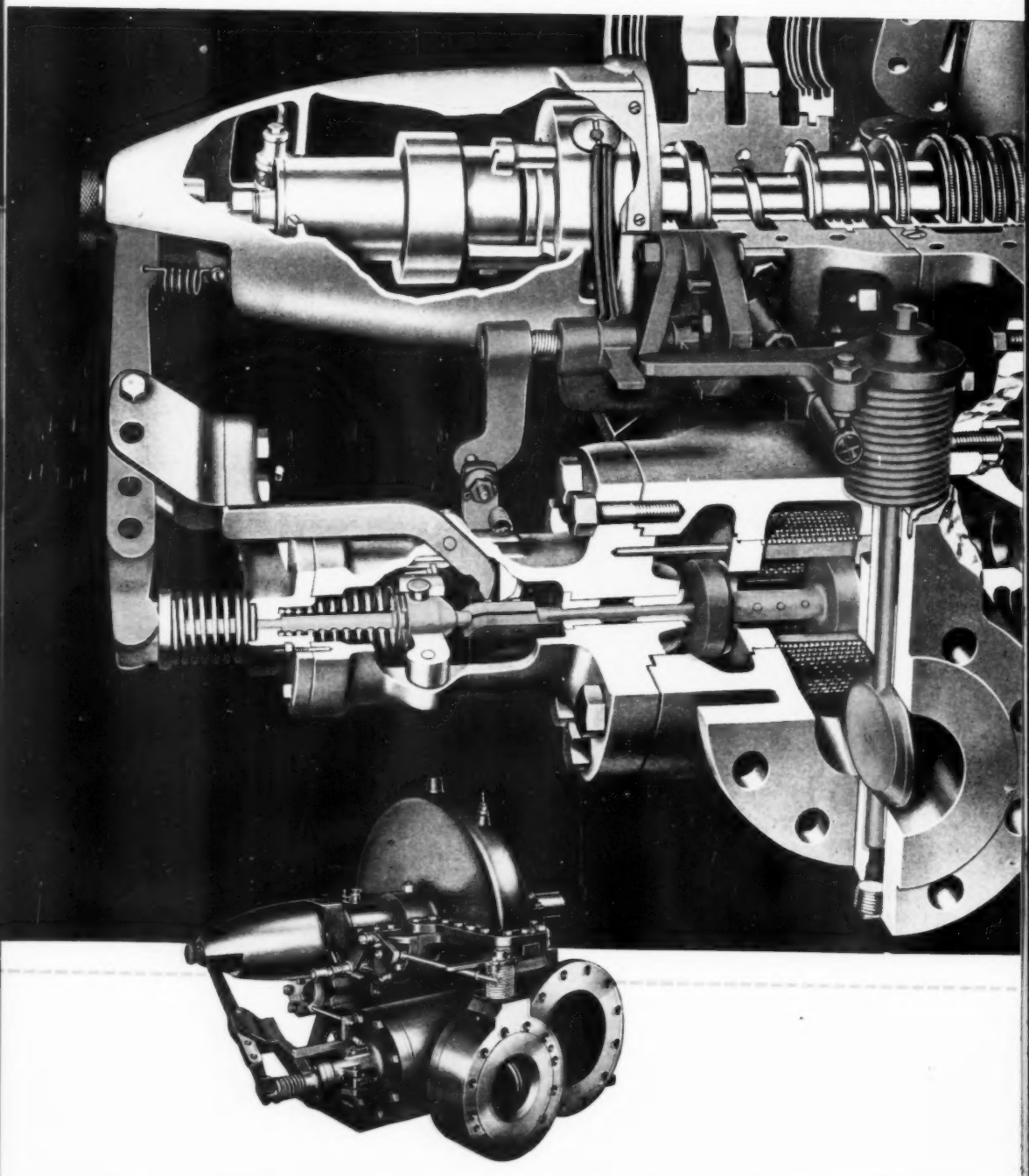


Compare it on ANY count

It's DOUBLE safe!

With Type E turbines, you can be sure of protection against overspeed. You can be doubly sure.

A sensitive, powerful centrifugal-weight governor provides extremely accurate speed control. Both the governor and its linkage connection are enclosed in a strong, specially-shaped housing to protect them from damage.

However, if for any reason the governor loses control, Type E *dual* protection takes over. A corrosion-resistant, spring-restrained weight, mounted in the governor hub, strikes a trip linkage . . . instantly closes the governor valve and an independent steam inlet butterfly valve. Steam is cut off positively . . . danger and resulting damage of overspeed are avoided.

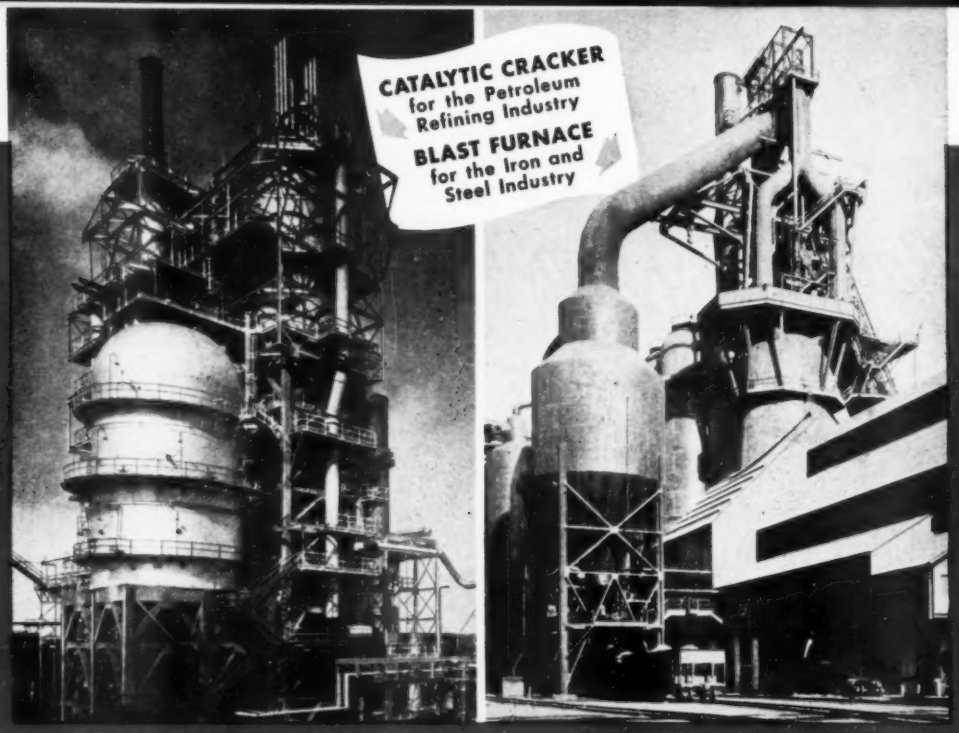
Dual protection is but one of the significant features of Type E turbines. Wrapped up in one standard unit are the best features of previous Westinghouse mechanical drives, plus important refinements and new developments that add up to economical, dependable service under all operating conditions.

We invite your comparison . . . on *any* count. Get the facts from your nearby Westinghouse office, or write for 20-page book B-3896. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50499

Westinghouse

TYPE E

Turbines



McKEE BUILDS *Processing Machines*

FOR BOTH OF THESE INDUSTRIES

WHAT OIL MEN AND STEEL MEN WILL TELL YOU ABOUT McKEE ENGINEERING:

They'll tell you McKee engineering is *thorough*—that McKee builds sound, practical production facilities for *both* industries.

McKee's knowledge and experience in oil and steel prove advantageous to McKee clients in each industry and has solved problems in other fields.

McKee service is prompt and construction rapid. That means lower costs and earlier completion of a profit producing plant.

Wherever iron and steel are produced or oil is refined, successfully operating McKee-built plants prove "*McKee Engineering means assured results*".

● It may be any type of refinery from a crude distillation unit to a catalytic cracker . . . a blast furnace, open hearth or ore beneficiation plant, but in each case *the plant is the machine.*

McKee builds these multi-million-dollar "plant-machines" for two of the world's basic industries—Petroleum Refining and Iron and Steel.

Where successful operation and profitable investment depend so much on the plant itself, plant design must be *correct*—engineering *thorough*—and construction *sound.* That's why oil men and steel men all over the world call on McKee for all types of production facilities.

ARTHUR G. McKEE & COMPANY

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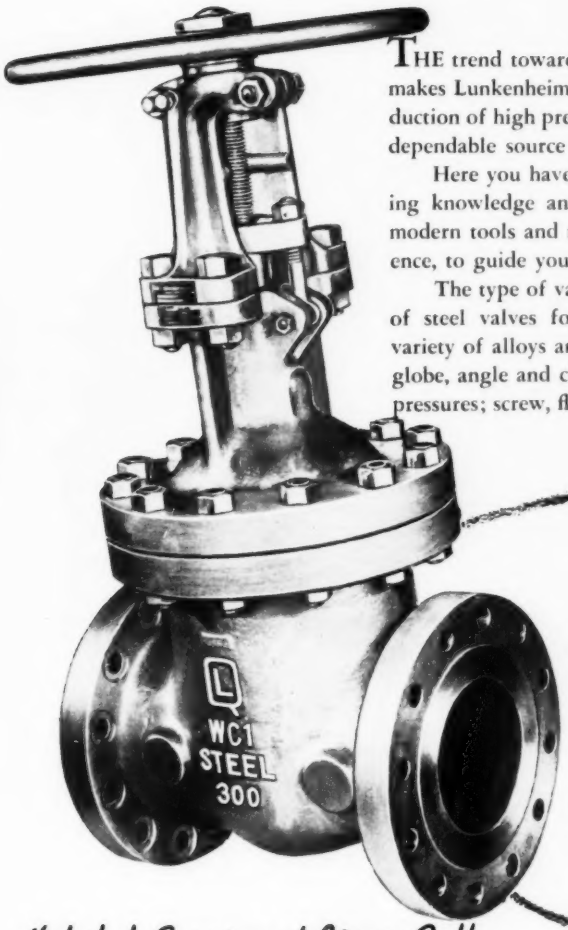
FOR *Steel Valves* YOU CAN'T GO WRONG ON LUNKENHEIMER

This mark on steel valves is your assurance of highest quality



THE trend toward wider use of steel valves for many services makes Lunkenheimer, who pioneered the development and production of high pressure-high temperature designs, a logical and dependable source of supply.

Here you have top metallurgical research, sound engineering knowledge and design, advanced foundry practice, most modern tools and manufacturing equipment, plus wide experience, to guide you in the selection of your requirements.

The type of valve illustrated is only one of a complete line of steel valves for every industrial purpose. Available in a variety of alloys and trims to suit specific applications . . . gate, globe, angle and check patterns, 150 lb. to 2500 lb. and higher pressures; screw, flange or welding ends.

300 lb. CAST STEEL GATE
Fig. 1938

Body and bonnet are of Carbon Molybdenum Steel. For steam, water, gas and air service, disc and stem are stainless steel, with high tin content nickel alloy seat rings—a fine-wearing combination developed by Lunkenheimer.

For oil and corrosive service, valves are furnished with stainless steel stem, disc faces and seat rings.

Lunkenheimer design and construction insure all the essentials for satisfactory and low-cost service.

Helpful Service at Your Call . . .

Lunkenheimer representatives and sales engineers will be glad to work with you on any problem of valve installation and usage. And for your immediate maintenance requirements, call your Lunkenheimer Distributor. He is well qualified to take care of your needs.

ESTABLISHED 1862

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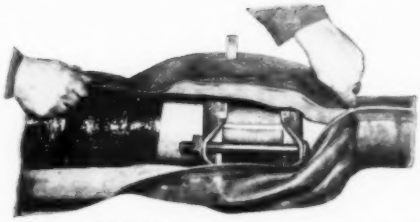
Leadership Through Achievement

Now—you simply "pull the zipper" on corrosion problems

Dresser ZIPCOAT for welded joints zips over weld area, fits closely to the pipe. 30" lengths.



Dresser ZIPCOAT for couplings is easy to install over joint and pipe ends—all in one quick operation. Has bleeder valve to vent air during backfilling.

NEW DRESSER ZIPCOATS* GIVE SURE PROTECTION, SUPERLATIVE DIELECTRIC STRENGTH

"As easy as zipping up a jacket" is what workmen say about Dresser's new ZIPCOATS. They install ZIPCOATS in 1/10 of the time it takes to coat a joint. You get protection that equals or exceeds that offered by the mill or yard-wrapped pipe.

And look at the hazards you avoid: there's no flame; no heating, hauling or messy application of hot stuff; no danger from fumes or burns.

Can be installed in any weather.

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*Every ZIPCOAT complete with anaerobic microbiological corrosion inhibitor and cold sealing compound. ZIPCOAT is a trade mark of Dresser Manufacturing Division.

Dresser ZIPCOAT for insulating joints is made like the ZIPCOAT for welds, but in ten-foot lengths. Installing one on each side of an insulating joint that's protected with a ZIPCOAT for couplings gives ultimate protection. Eliminates costly boxing and filling with dope. Immediate trench backfill saves time.

Install Dresser Insulating Couplings IN MINUTES

Dresser Style 39 Insulating Couplings with new plastic gaskets insulate effectively and are the simplest insulating type joint to install. Sizes 2" to 30" and up.

New Dresser Bonding Method saves up to 50% of cost; materials preformed

Fast bonding, giving low resistance with *pre*formed Dresser Bond and 5-second chemical welding method. Needs no special skill, no bulky equipment. Makes homogeneous weld area, eliminates surface contact variables. Compact kit of 50 *pre*formed bonds includes all materials needed for installing.

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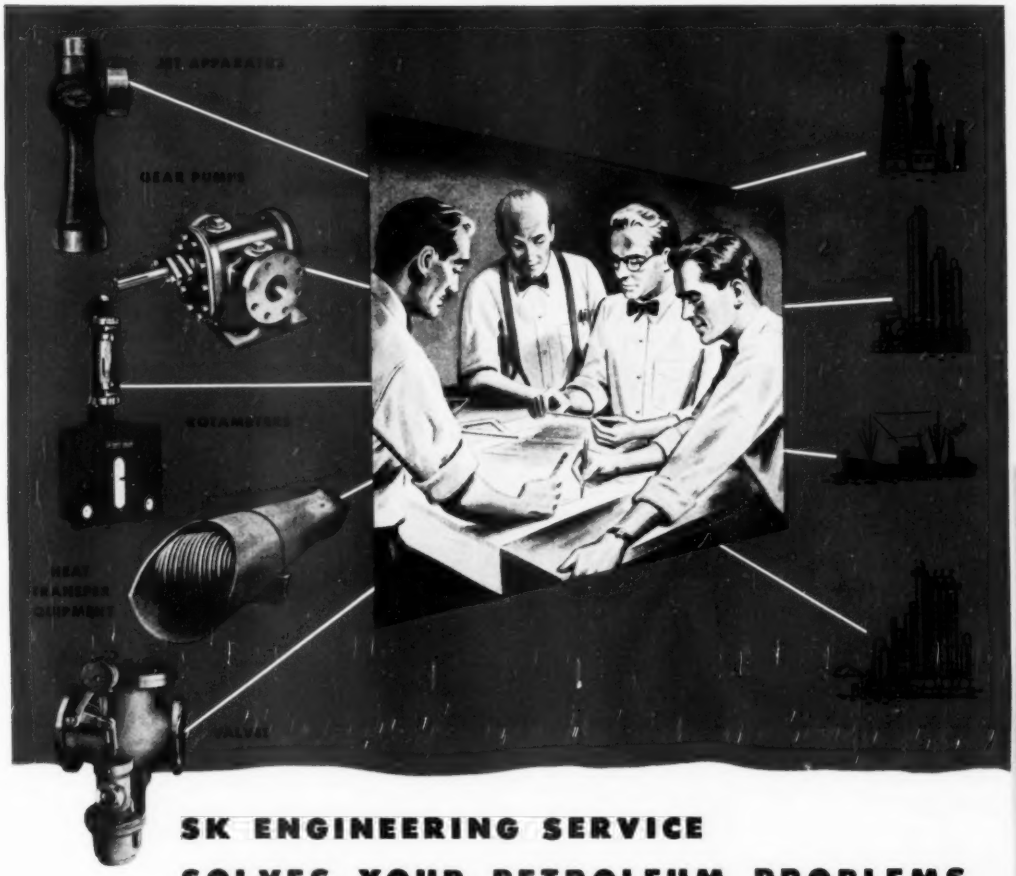
Headquarters: Bradford, Pa. (One of the Dresser Industries). Sales Offices: New York, Philadelphia, Chicago, Houston, San Francisco. In Canada: 629 Adelaide St., W., Toronto, Ontario.



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The many types of equipment bearing the SK mark are designed and built to render years of outstanding performance. SK Engineers have long been aware of the necessity for engineering each specific application to assure the user of full performance value, economy and satisfaction. That's why SK Engineering Service is maintained for all those faced with problems involving the use of SK products in the producing, gas processing, refining or transporting phases of the industry.

An amazing amount of problem-solving knowledge has been accumulated in our seventy-odd years of engineering and manufacturing equipment for the petroleum industry. Since that knowledge is available for your use, why not use it?

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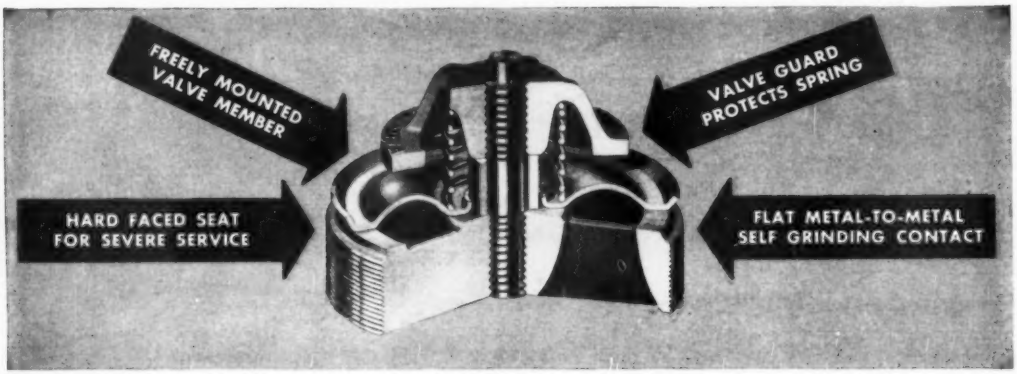
DURABLA

METAL PUMP VALVE UNITS
KEEP YOUR PUMPS IN SERVICE


FREELY MOUNTED VALVE MEMBER
VALVE GUARD PROTECTS SPRING
HARD FACED SEAT FOR SEVERE SERVICE
FLAT METAL-TO-METAL SELF GRINDING CONTACT

1 **THEY ARE SELF-GRINDING:** Durabla Valve Units*, utilizing the freely mounted arched construction valve member exclusive to Durabla, are self-grinding, as the flat portion of the valve member is in direct contact with the flat valve seat and is free to move about its axis, thus producing a constant self-grinding action.

2 **VALVE SEATS ARE HARD FACED FOR SEVERE SERVICE:** Providing a seat surface hardness of Rockwell C-48-52 (approximately 500 Brinnel) or more in special valves, Durabla Valve Units have a long record of effective service with FLUIDS CARRYING SUSPENDED ABRASIVE SUBSTANCES. The metal valve member effectively prevents the pitting or "pick-up" of abrasive substances sometimes occurring with valves made of other materials.

3 **VALVE SPRINGS AND VALVE STEMS ARE PROTECTED:** The Valve Guard protects the Valve Spring from ever compressing more than 50% of its length. The Valve Stem is protected against breakage by the free mounting of the Valve Member.

Economy, efficiency and adaptability, based on long established service records and exclusive design make Durabla Valves your guarantee of reliable, uninterrupted pump operation.

You can specify Durabla Valves when you order a pump, (many manufacturers use them as standard equipment), or you can order Durabla Valves to fit any type of reciprocating pump, (they come with drive-fit seats or threaded seats with or without a shoulder to suit the job).

TO AVOID "PUMP TROUBLES" SPECIFY DURABLA VALVES

Address DURABLA Engineering Department for information and bulletin: Reference OG-3

*Patent Numbers 2090486, 2117504

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. . . the Lowest Priced, Full-Port-Area Plug Valves In Their Rated Working Class

If you're using a venturi (restricted-port-area) valve with an opening of say, 60% standard pipe area, you are operating at reduced line pressure. To be sure of nearly full line pressure, you must use a larger size venturi, which of course means a higher priced valve . . . perhaps as much as 30% higher!

For example: **A 2½" Homestead-Reiser has a 100% full-port-area, or 4.78 sq. in. The 2½" size in 60% venturi pattern has only 2.87 sq. in. port area. To approximate the full-port-area of a 2½" Homestead-Reiser valve, a 3" venturi must be used. And even then you'll have less than Homestead-Reiser's full-port-area.**

In the light of this evidence doesn't it stand to reason that Homestead-Reisers with their 100% full-port-area are sound economy?

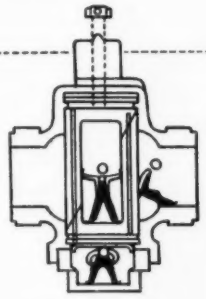
Truly, from the standpoint of both first cost and length of service, they are the lowest priced, full-port-area lubricated plug valves in their rated working class!

For complete information, write for Catalog 39, Section 5. We'll mail it to you promptly.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892"

P.O. Box 403 Coraopolis, Pa.



"SELF-SEALD" MEANS

. . . that in addition to a full-port lubricant seal the wedge-action of the plug under line pressure, forces the finished surfaces of the plug outward and constantly presses them against the seating surfaces of the body, thus keeping them always in intimate contact. The plug automatically adjusts itself for wear, assuring extra long life, maximum leakless service and lubricant economy.

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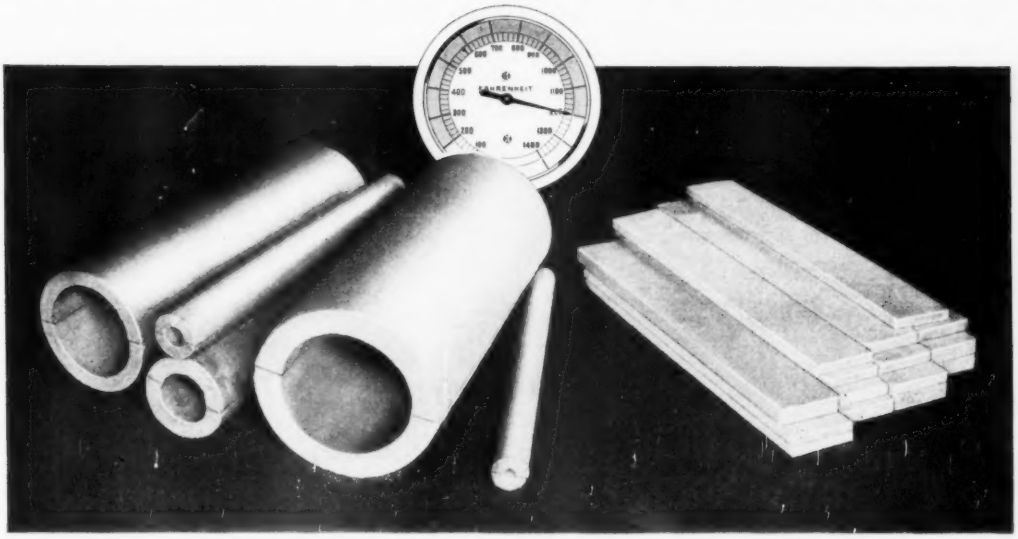
MORE and MORE REFINERIES USE *LCP EVERY DAY!

Always on the job—that's me! And with refiners that's what counts! No costly shut-down time when I'm delivering my constant, trouble-free service! I can take on a 24-hour shift or work according to any fractional time schedule. Automatic control does the trick—and saves you money on maintenance and labor. The Power Engineer of your Utility Electric Power Company has files galore on successful power conversions. Get the facts from him!

*LOW COST POWER

PETROLEUM ELECTRIC POWER ASSOCIATION

ONE MATERIAL INSULATES A 200°F.-1200°F. TEMPERATURE RANGE



KAYLO HEAT INSULATING BLOCK can be easily sawed, cut and scored with standard tools. Cement, canvas or other outer finishes can be applied with minimum effort. Finished jobs have a neat, clean appearance.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when necessary. Available in thicknesses from 1 to 3 inches in 36-in. sections for pipe sizes from ½ inch to 12 inches.

Every engineer concerned with insulation problems should know about Kaylo Heat Insulating Block and Pipe Insulation. No other insulation provides such a combination of advantages.

Available in block or pipe covering form, this material is remarkably efficient throughout a wide 200°-1200°F. temperature range. It is strong and resistant to effects of moisture for long service. It is lightweight, easy to handle and apply.

Many types of industries have found this material ideal for their insulating needs. Get the facts now about Kaylo Heat Insulating Block and Kaylo Pipe Insulation.

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HEAT INSULATING BLOCK and PIPE COVERING

OWENS-ILLINOIS GLASS COMPANY
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CITY.....STATE.....

OIL TANKS USE BARCO BALL JOINTS to RELIEVE SHOCK and STRAIN

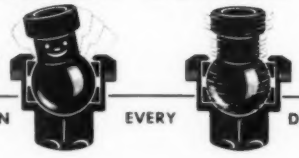
Barco ball joints are used on this pipe line in the oil fields to allow for tank-settling, to relieve earthquake shocks and any strains on costly valves. Barco also facilitates quick break-down and setting-up of drilling rig equipment.

This is one of the many, many applications of Barco Joints in practically every field of industry and transportation. By responsive movement through every angle, Barco absorbs strain and stress, compensates for expansion and contraction, minimizes corrosion from electrolysis. Furnished in heavy as well as standard patterns, with flanged as well as screw ends. Fire-proof and capable of handling high temperatures. Write for full information to Barco Manufacturing Company, 1839D Winnemac Ave., Chicago 40, Illinois. *In Canada:* The Holden Co., Ltd., Montreal, Canada.

BARCO ***FLEXIBLE JOINTS***

Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY



"MOVE IN EVERY DIRECTION"

Channels released for private industry, July 1, 1950!

Now the BUSINESS END of Management's New Tool

INTER-LOCKING COMMUNICATION

...Steps up production!
Keeps all your forces pulling together in one smooth action. Keeps expensive equipment in peak production with other inter-dependent units, by eliminating costly waiting, shortening stoppages and dead-mileage. Reports are proving its efficiency in cutting, snaking, loading, and scores of other applications. It pays for itself in other ways too —as a morale-building safety factor, getting over the bad spots, it lets a man know when and what to do in relation to the entire operation.

With Motorola to Help You Get the Finest 2-Way Radio System at the Best Buy!

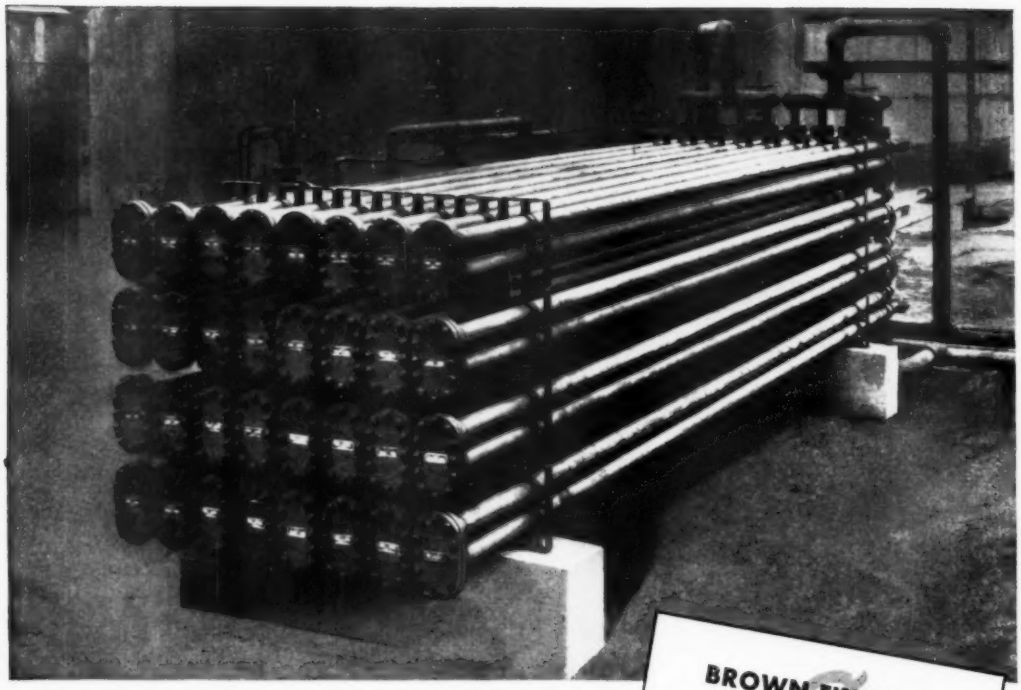
Motorola's factory engineers are immediately available to help you plan the best application to your operations—to meet your present and growing needs—plans you can fully rely upon to protect your investment for many years to come. By providing "tomorrow's equipment today," Motorola's *systems designing* gives you consistently finer performance at the lowest over-all cost, in a tough, durable package, and protects against obsolescence in the future.

Your request for planning your own special application will be promptly and courteously treated by the WORLD'S LARGEST LABORATORIES DEVOTED EXCLUSIVELY TO MOBILE RADIO COMMUNICATION SYSTEMS

Only Motorola makes the "Handie-Talkie" Radiophone!

Motorola

in Canada: Rogers Majestic Ltd., Toronto



extreme flexibility

Brown Fintube Sectional Heat Exchangers

are easily adaptable to changes in duty

● You'll get almost unlimited flexibility to meet changes in duties, plant re-arrangements, etc., with Brown Fintube Sectional Heat Exchangers. The banks can be changed over *easily* and *quickly*, to operate *efficiently* on almost any *new* and *different* duty. You simply add a few sections, remove a few sections, or change the series-parallel manifolding.

For the utmost in efficiency and economy use Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

BROWN FINTUBE'S 6 *advantages*

EXTREME FLEXIBILITY
Easily Adapted to Changes in Duty

NO OBSOLESCENCE
Avoiding Waste and Expense

FLANGED HEAD END ASSEMBLY
Eliminating Ground Joint Seals

EASY MAINTENANCE
Using Only Common Tools

CONTINUOUS OPERATION
No Shut-Downs For Cleaning

REDUCED STORES REQUIREMENT
Minimizing Investment and Handling

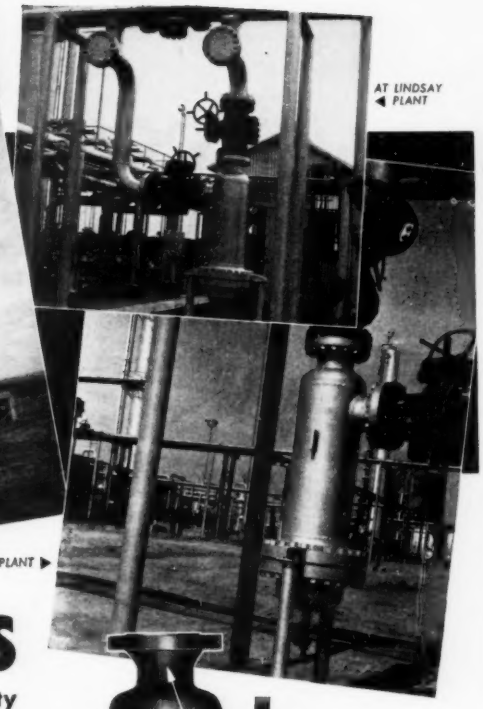
QUICK DELIVERY
Only a Few Hours in Emergency

INCREASED CORROSION ALLOWANCE
Longer Tube Life

THE BROWN FINTUBE CO.
ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS

AT MAYSVILLE PLANT



AT LINDSAY PLANT

AT ANTIOCH PLANT

Staynew FILTERS

in the New Garvin County Plants Protect Compressors, Prevent Injection Well Plugging!

Here, in one of the newest and largest operations of its kind in the entire world, Staynew Filters provide all-important protection for equipment and processing.

In each plant, a Staynew Model HPH Filter removes aluminum oxide generated in the dehydration process from approximately 40 million cu. ft. of gas per day. This aluminum oxide, in the form of an abrasive powder, would cause serious damage if allowed to pass steadily into the lines and equipment which subsequently handle the gas.

In the Antioch Plant, where dehydrated gas is re-pressured to 2400 lbs. and injected into the reservoir, the Staynew Filter not only positively protects the 3 extra re-pressuring compressors against excessive wear, but prevents the pores of the oil-bearing sand from becoming plugged with aluminum oxide.

All Plants Operate Night and Day the Year Around

Such continuous operation would ordinarily require dual installations. However, due to the exclusive Staynew design, a *single filter* only was required at each plant. A by-pass is provided for use during the time required for cleaning or replacement of inserts. Experience indicates that such servicing is not necessary oftener than twice a year, and that only two hours is required for the operation!

This group of filters represents only one of the thousands of Staynew installations in critical service throughout industry. As a result of the many problems solved during these installations, an unsurpassed fund of information in this specialized field has been acquired. For help in solving *your* filtration problems, contact your Dollinger representative, or write direct, care of Dollinger Testing Laboratory.

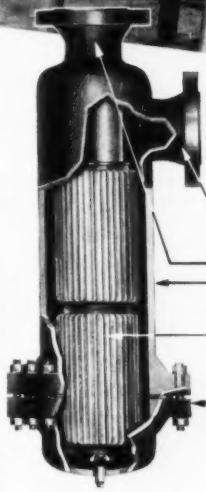


Diagram and Specifications of STAYNEW FILTERS in Service at Garvin County Plants

- Inlet.
- Outlet.
- Forged steel shell, 7/8 in. thickness, certified for 800 lbs. pressure.
- Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.
- Bolted Head, 32 in. x 3½ in. flanges.

Wt. 3425 lbs.

DOLLINGER CORPORATION

5 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER REG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

BLOOMING AGENTS
FLUORESCENT COLORS
for
Solvent extracted and additive compounded lube oils

•

"PETROL" colors for gasoline, kerosene, diesel and tractor fuels:

BRONZES • AMBERS • BLUES • GREENS • GOLDS • YELLOWS
PURPLES • ORANGES • REDS • BROWNS • BLACKS

•

SPECIAL PRODUCTS FOR THE PETROLEUM INDUSTRY

PETROL BLUE WHITENER R and B are used to neutralize undesirable yellow shades in uncolored gasoline or kerosene.

DEBLOOMING AGENT A has the property of neutralizing blooms in lubricating oils.

N. P. A. COLOR has the property of changing body color of pale oils to red cast without affecting natural fluorescence.

COLOR SOLVENT No. 9 increases brilliance and solubility of colors in waxes and oils.

•

GASOLINE ADDITIVES

INHIBITORS FOR GASOLINE, OILS, RUST . . . HIGH PRESSURE LUBRICANTS, STABILIZERS, EMULSIFIERS, DETERGENTS, WETTING AGENTS, DISPERSING AGENTS.

The "PATENT" laboratories and technical staff are available for the development of special colors or for the solution of any color problem.

PATENT CHEMICALS, INC.

25 years continuous manufacturing of colors for the petroleum industry

PATENT FUEL & COLOR CORP. PATENT CHEMICALS, INC.

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Cincinnati 2, Ohio

PIONEERS IN GASOLINE COLORS
ANTHRAQUINONE DYES

MANUFACTURING DIVISION

335 McLean Boulevard
Paterson 4, New Jersey

FIRE-PROOF!

inside and out!

CMH REX-FLEX FIRE-PROOF FLEXIBLE METAL HOSE

FOR: Fuel and Process Lines and Fire Protection Systems

For services where the combustibility of materials handled demands that flexible connections be resistant to internal or external fire, CMH manufactures a truly *fireproof* flexible metal hose. Already widely used in critical applications, CMH REX-FLEX Fire-Proof Flexible Metal Hose has been subjected to the severest tests. Its use in processing plants and fire protection systems will provide new highs in safety not available in standard type hose assemblies.

CMH REX-FLEX Fire-Proof Flexible Metal Hose is available in sizes from 5/16" to 6" I.D. with a choice of standard fittings. Write for latest data and specifications for your requirements.

Undamaged after 10 hours of continuous internal fire . . .

In certified tests, CMH Fire-Proof Metal Hose was subjected to 10 hours continuous internal fire — without damage! It also withstood an external flame of over 2000°F. for over fifteen minutes—again without failure!

Here is a degree of safety that cannot be found in other types of hose construction!

CMH—ONE dependable source for every flexible metal hose requirement

• CMH manufactures all standard types of flexible metal hose, both convoluted and corrugated, in a variety of metals; expansion joints for piping systems; stainless steel and brass bellows; various conduits and special assemblies of these components.

CHICAGO METAL HOSE CORPORATION

Leaders in the Science of Flexonics
MAYWOOD, ILLINOIS
Plants at Maywood, Elgin and Rock Falls, Illinois
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario

FLEXON . . . . . identifies CMH products which have served industry for more than 47 years.

Kellogg's unique devices aid in producing special types of process piping

NOT only does Kellogg fabricate virtually any type of process piping from carbon steel to alloy and alloy-lined, but it also rolls, welds and forms it from plate in sizes beyond those readily available from tube mills.

When it comes to fabricating and bending, size is limited only by what can be shipped. One-piece bends up to 96-inch diameter are made on an exclusive bender. Larger diameter bends are made from welded segments. Small diameters are handled on regular bending tables and fabricated into sub-assemblies to minimize field labor. Another unique machine produces quality corrugated pipe for expansion bends.

If you are in the market for process piping of any kind, look to Kellogg!

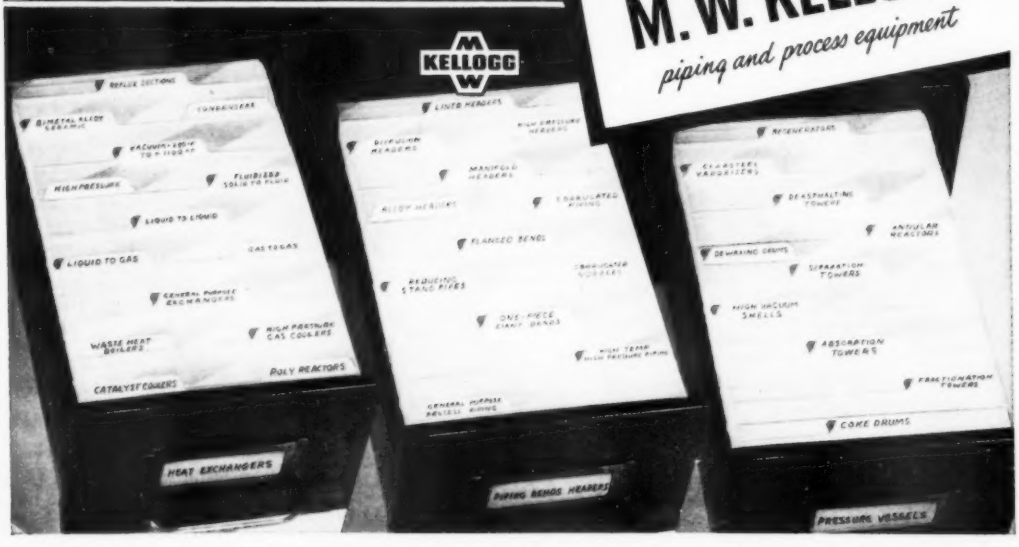
Exclusive!!! One-Piece Giant Bends

If you require smooth interior contour on piping larger than 36 inches, it will pay you to investigate the advantages of Kellogg's *one-piece giant bends.*

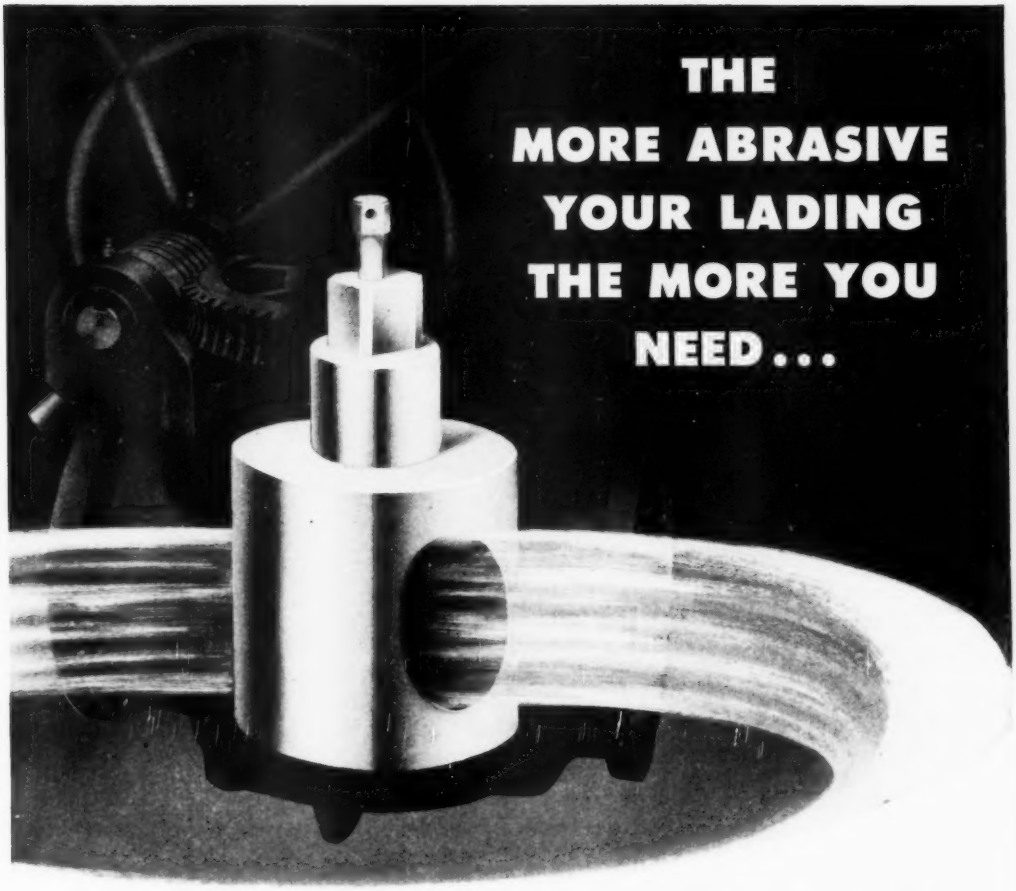
To master temperature and pressure use

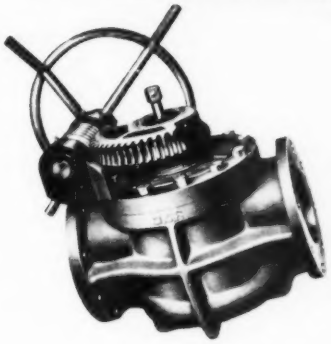
M. W. KELLOGG

piping and process equipment



The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris





a.c.f. cylindrical plug valves

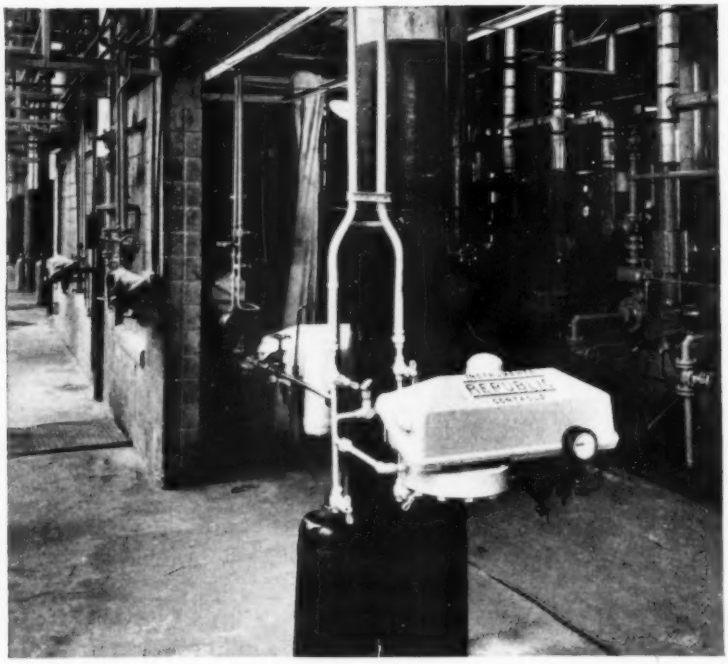
They alone provide the full-pipe-area passage, and straight-through round* porting, that can banish abrasion troubles. Lubricant-sealed from contact with the lading, the precision-machined plug does not wear or need attention, other than an occasional turn of the lubricating screw. Why use less efficient valves?

*Also available with full-pipe-area rectangular port.

a.c.f. CYLINDRICAL FULL PIPE AREA LUBRICATED PLUG VALVES

Representatives in more than 50 principal cities

Write for Catalog 4-OG, describing types and sizes, to: American Car and Foundry Company, Valve Division, 30 Church Street, New York 8, N. Y.



These Meters Had To Be
ACCURATE — FLEXIBLE — RUGGED

One hundred twenty one Republic Pneumatic Transmitters are measuring the flow and level of various acids in a large chemical processing plant, a section of which is pictured above.

These transmitters have a guaranteed accuracy of within $\frac{1}{2}$ of 1% of the transmitter range. By making a few minor adjustments or substituting a few small parts, their operation can be easily changed to any desired range between a minimum of 0—0.6" of water to a maximum of 0—704" of water. Their construction is more like that of a precision machine than of the sensitive instrument they are. It is for these reasons that Republic Pneumatic Transmitters, even though comparatively new, have already been specified and installed on over 2500 industrial metering applications.

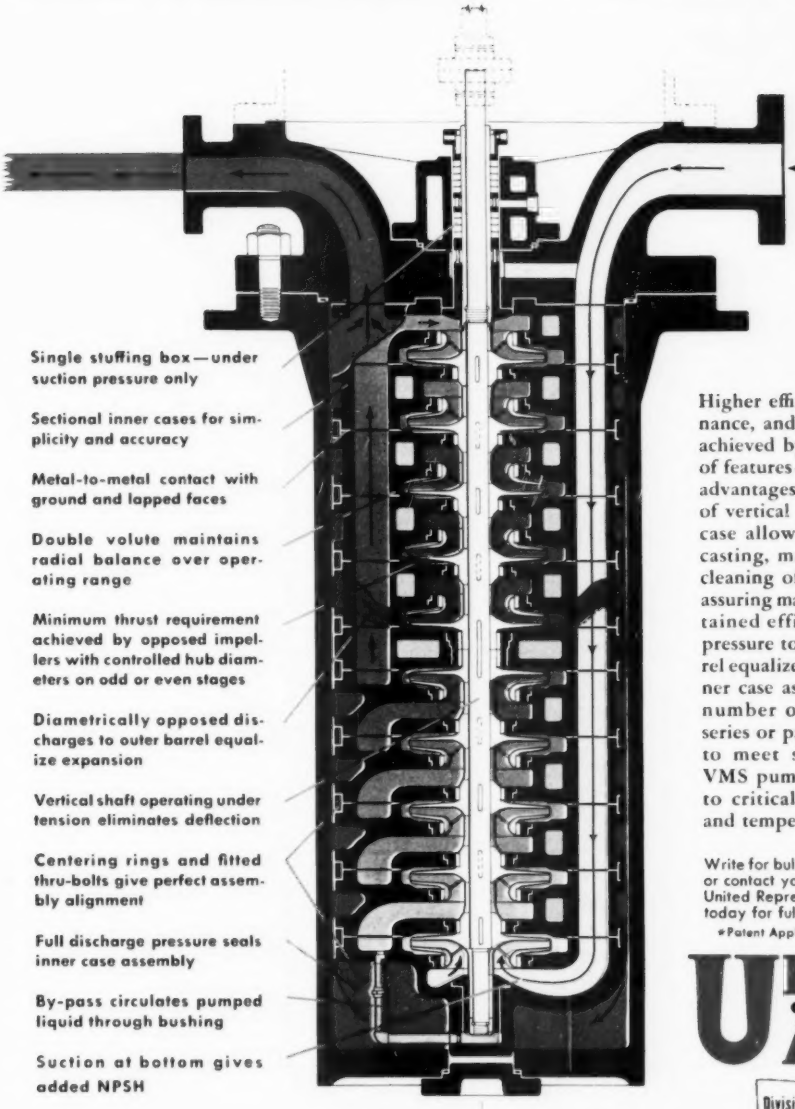
Republic Pnuematic Transmitters are available for measuring flow, liquid level, pressure or liquid density of a wide range of fluids. They employ the force-balance principle to convert these process variables into air pressures which vary proportionally. These air pressures become direct measurements and can be conducted to reading instruments or used as the measuring impulse for the actuation of an automatic controller.

Data Book No. 1001 contains complete details on the construction and operation of Republic Transmitters. Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

UNITED VMS* SERIES offers

New Potentials in vertical pumps



- Pressures to 5000 lbs.
- From sub-zero to 900° F.
- For process, pipeline, boiler-feed, water-flood, and hydraulic pressure systems

Single stuffing box—under suction pressure only

Sectional inner cases for simplicity and accuracy

Metal-to-metal contact with ground and lapped faces

Double volute maintains radial balance over operating range

Minimum thrust requirement achieved by opposed impellers with controlled hub diameters on odd or even stages

Diametrically opposed discharges to outer barrel equalize expansion

Vertical shaft operating under tension eliminates deflection

Centering rings and fitted thru-bolts give perfect assembly alignment

Full discharge pressure seals inner case assembly

By-pass circulates pumped liquid through bushing

Suction at bottom gives added NPSH

Higher efficiency, reduced maintenance, and extreme flexibility are achieved by a unique combination of features—with the space-saving advantages and lower initial cost of vertical design. Sectional inner case allows uniform accuracy in casting, machining and periodic cleaning of all hydraulic passages, assuring maximum initial and maintained efficiency. Full discharge pressure to both sides of outer barrel equalizes expansion and seals inner case assembly. In any required number of stages—singly or in series or parallel—with metallurgy to meet specifications, United VMS pumps offer new solutions to critical problems in pressure and temperature.

Write for bulletin No. 1-150, or contact your nearest United Representative today for full details.

*Patent Applied for

UNITED CENTRIFUGAL PUMPS

Division of United Iron Works
Since 1859

Main Offices and Plants: Oakland 7, California

Sales Offices: LOS ANGELES • HOUSTON • DENVER • TULSA • ST. LOUIS • CHICAGO • CLEVELAND • NEW YORK

CALL ON "MAINTENANCE"

FOR YOUR REQUIREMENTS OF HIGH PRESSURE SPECIALTIES

Large Houston stocks of the following nationally-recognized products:

- **STAINLESS STEEL** Stud Bolts, Nuts, Cap Screws, Ells, Tees, Unions, Couplings, as well as forged Steel, 3000- and 6000-lb. working pressure.
- **MASON-NEILAN** Reducing and Back Pressure Regulators—Liquid Level Controllers—all types for Oil, Gas, Steam or Water service.
- **CAST STEEL** Flanged End Gate Valves, Forged Steel Globe Valves, Gate and Check Valves.
- **SEAMLESS STEEL** Tube-Turn Welding Fittings, Ells, Tees, Caps and Reducers; Forged Steel Flanges—threaded, slip-on, welding neck, and blind—in sizes from ½" to 24" O.D.
- **HAGAN** Control Equipment, Hall Laboratories Water Conditioning.
- **NATIONAL** Seamless Steel Pressure Tubing, Seamless Steel Heat Exchanger and Condenser Tubes.
- **SMITH** Meters and SPARLING Meters, for your measuring problems in oil, gas, water, and other liquids.

YOUR INQUIRY IS INVITED

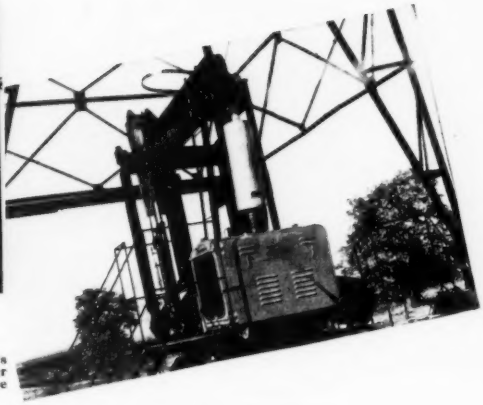
MAINTENANCE ENGINEERING CORPORATION

3611 CLINTON DRIVE
P. O. BOX 9637,
HOUSTON 1, TEXAS

EQUIPMENT WITH ENGINEERING SERVICE

MECO

Lufkin rig, in East Texas field, powered by Waukesha 140-GKU Power Unit (6 cyl., 4½ in. x 5½ in., 525 cu. in).



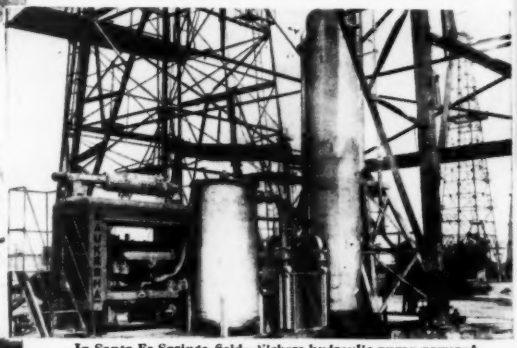
At Witcher Pool, Oklahoma County, Okla., Peppers Refining Co. is using Waukesha 6-MZAU Gas Power Unit (6 cyl., 4¼ in. x 4¾ in., 404 cu. in.) to drive air balanced deep well pumping unit.

WAUKESHA

powers the pumps!

● Just start 'em, and then forget 'em—Waukesha Oil Field Power Units will keep on pumping along. All day, all week, on and on . . . no attention needed, just routine inspection and check up. Waukeshas are *that* reliable. And that's a fact that most any oil man takes for granted by now. That's why there are so many Waukeshas, no matter what field you're in. Flexibility goes with that reliability, and Waukeshas run right smoothly. Cost less to operate and keep up, too. For details and specifications, send for Bulletin 1408.

In a Canadian oil field—American Mfg. Co. pumping unit powered by Waukesha XAHU Power Unit (4 cyl., 3⅝ in. x 4½ in., 186 cu. in.).



In Santa Fe Springs field—Vickers hydraulic pump powered by Waukesha 6-WAKU Gas Power Unit (6 cyl., 6¼ in. x 6½ in., 1197 cu. in.).

E. H. Moore, Inc., Jessie Pool, Stonewall, Okla., uses VIKU (4 cyl., 4½ in. x 5¼ in., 334 cu. in.)

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.

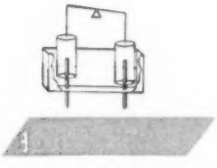
NEW YORK ● TULSA ● LOS ANGELES

WAUKESHA

Diesel Power... *...Gas Power*

POWER

ONLY BROWN GIVES YOU



. . . with this choice of elements

WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL
COMMERCIAL · RESIDENTIAL · INDUSTRIAL

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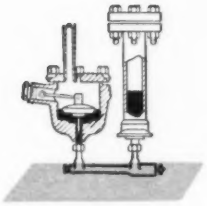
Offices in 77 principal cities of the United States, Canada and throughout the world

THE PRESSURE GAUGE

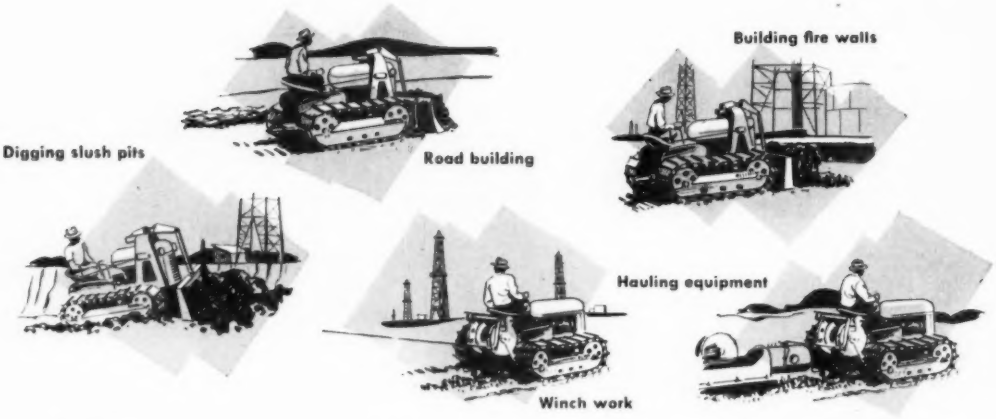


THE BROWN PRESSURE GAUGE has long been the standard of comparison for almost all of industry... because of its continuous, trouble-free performance and its unmatched sensitivity.

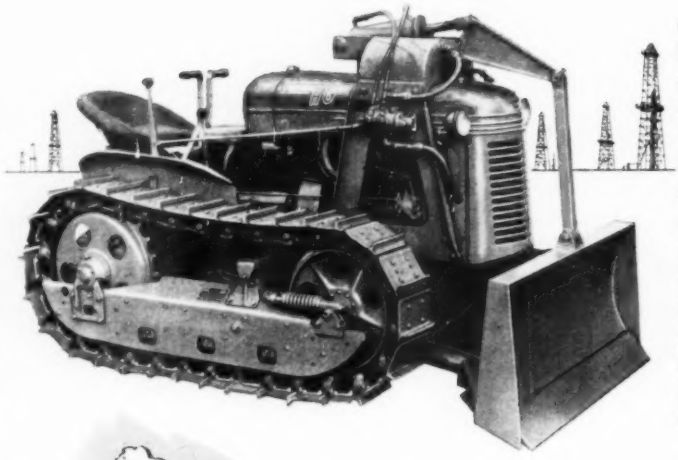
Its performance is the result of engineered design, rugged construction and simplicity of operation. The wide range of measuring elements is responsible for its sensitivity. There's a specific element for every pressure application... from microns to tons ... from corrosive to non-corrosive.

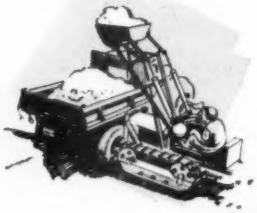
Your local Honeywell engineer is as near as your phone. Call him in for a discussion of your pressure problems... or write for a copy of Catalog 7000!

MINNEAPOLIS Honeywell — *Advanced Instrumentation* FOR THE PETROLEUM INDUSTRY — BROWN INSTRUMENTS



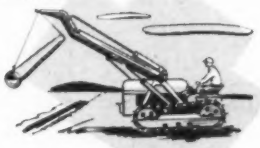
Where can You use this Tractor?





Loading

Handling pipe



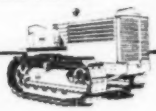
● We'll be frank and say we don't know of *all* the uses around field and refinery where this powerful little tractor can help your operations We do know of many operations the Oliver HG . . . the smallest crawler tractor on the market . . . is performing today. But, it seems that every day someone comes up with a new use. So we'll just say that wherever you need a small but powerful prime mover . . . where low operating and maintenance costs are important, you can use the Oliver HG in your operations.

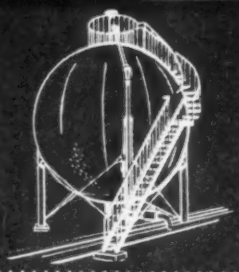
The illustrations will give you a rough idea of the versatility and usefulness of this handy little tractor and its line of accessory equipment. For information, write The Oliver Corporation, 19300 Euclid Avenue, Cleveland 17, Ohio.

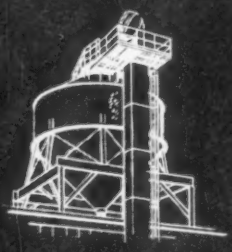
THE OLIVER CORPORATION

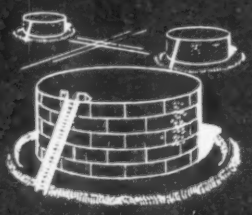
Industrial Division: 19300 Euclid Avenue, Cleveland 17, Ohio

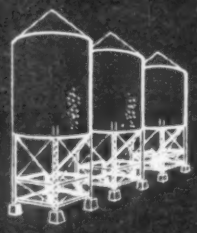
A complete line of crawler and industrial wheel tractors

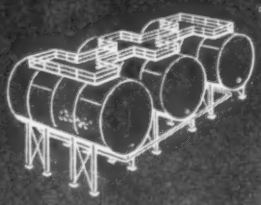












How to Solve

YOUR MATERIALS STORAGE PROBLEM!

PITTSBURGH · DES MOINES Research

develop the answers for you

Finding the *right answers* to questions of efficient materials storage is a primary Pittsburgh-Des Moines activity.

Our research engineers, and our Chemical Storage Fellowship at Mellon Institute for Industrial Research, conduct a continuous program of study on storage problems from many fields, which is translated into better design, materials and methods by our fabricating divisions for the customer's benefit.

We will be glad to help with your own storage problem, if you will send us an outline of the factors involved.

PITTSBURGH · DES MOINES STEEL CO.

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BETTER BECAUSE THEY ALONE OFFER ALL THESE FEATURES

No matter what conditions your application imposes on an engine . . . no matter what oil field job you have in mind . . . you'll find Continental Red Seal power your one best choice. For Continental alone embodies ALL the features on which top performance, economy and reliability depend. The modern Continental line, moreover, is broader and more diversified today than at any time in the past. It includes overhead-valve and L-head models for use with all standard fuels—models ranging from 1½ to 140 horsepower, for virtually every oil field and industrial use. *Write for free bulletins, stating your application. Continental engineers will be glad to discuss your needs.*

CONTINENTAL MOTORS ★ Powerful as the Nation ★ AMERICA'S STANDARD

ONLY CONTINENTAL OFFERS ALL THESE FEATURES

Patented Continental system of individual porting, assuring uniform fuel supply to all cylinders, for fast starting and smooth, economical operation.

•

Directional cooling and full-length water jacketing, for high efficiency and long trouble-free life.

•

Leakproof water pump, with impeller mounted on two widely-spaced ball bearings; corrosion-resistant seal of stainless steel.

•

Patented oil and dust seals keep lubricant in, and dust, chaff and moisture out, minimizing wear on moving parts.

•

Removable tappets for easy access without pulling camshaft.

•

Forged alloy-steel crankshaft with Tocco-hardened journals; each shaft statically and dynamically balanced.

•

Roto valves, sodium-cooled exhaust valves and stellite valve seat inserts in models where required.

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6218 CEDAR SPRINGS ROAD • DALLAS 9, TEXAS
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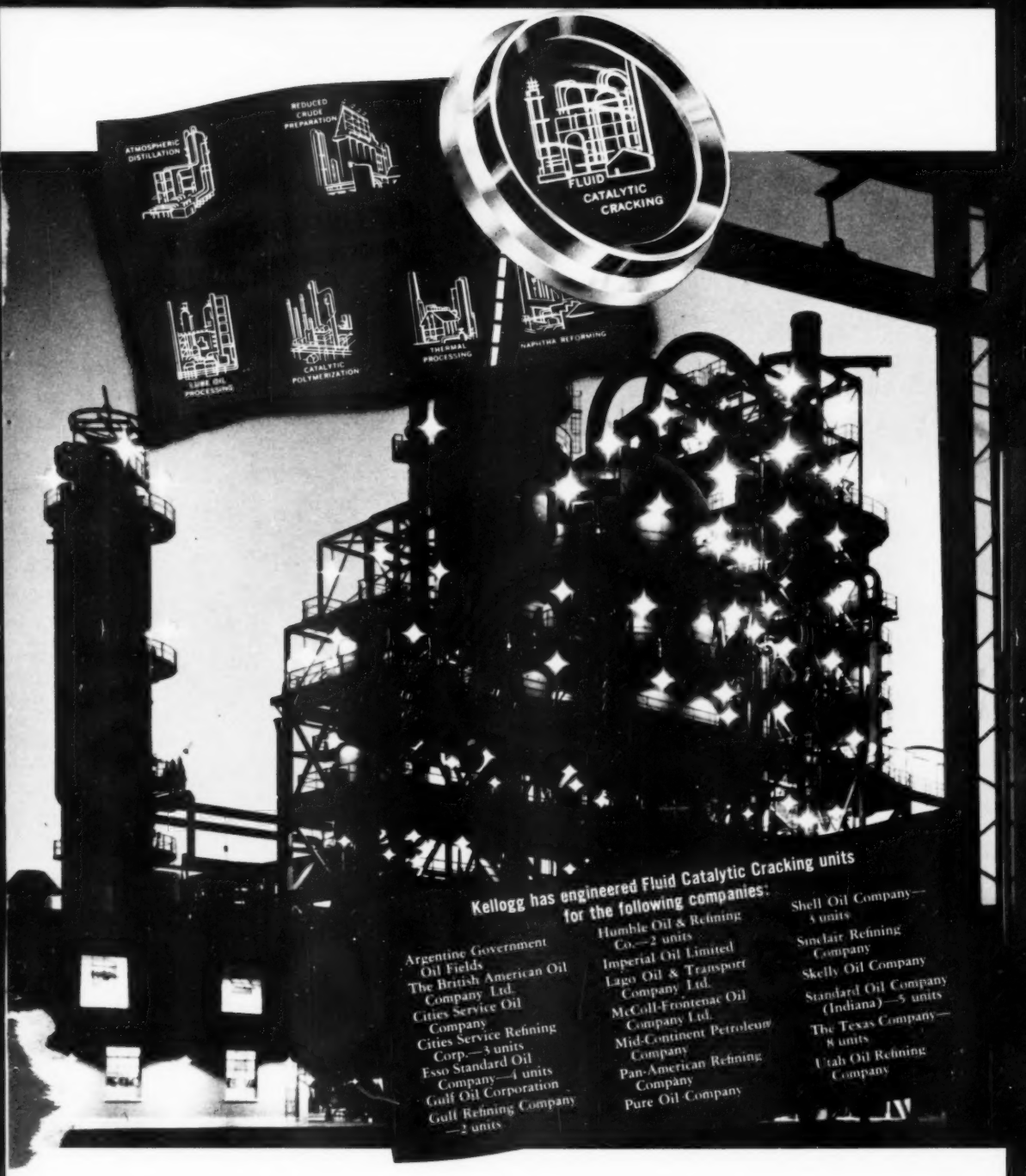


More than 250 million barrels of oil will be cracked this year in Kellogg-engineered Fluid catalytic crackers...

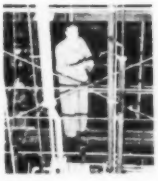
...Yes! Kellogg-engineered Fluid Catalytic crackers have a combined daily fresh feed capacity of better than 750,000 barrels...and there's more coming!

THIS isn't surprising when you consider the history of the process. During the period when the process was being evolved, Kellogg engineers and laboratories made many key contributions. And since the first years of actual commercial use of the process—war years when virtually the entire industry "froze" on a standard design—Kellogg has made tremendous strides in perfecting various phases of the process. Naturally, the search for additional improvement still continues . . . and year after year produces further economically-desirable innovations.

That's why Kellogg invites all refiners who are contemplating addition of Catalytic Cracking units to see for themselves the latest innovations in Catalytic Cracking. It may be the customary two-vessel unit or it may be the new ortho-flow unit with a single integrated vessel. BUT regardless of the type of unit required for your operation, it would seem reasonable that the best place to obtain that unit is at Kellogg, where FLUID Catalytic Cracking was developed into the giant it is today . . . and where it is being *continually* studied to determine possible additional improvements.

"CAT" EFFICIENCY DOMINATES REFINERY EARNING POWER—

even minor process improvements mean major earning increases.



Two full-scale pilot plants now operate at the Kellogg laboratories, supplementing operating reports from the numerous Kellogg commercial units. In addition, many separate studies are continually conducted on such subjects as the composition of the fluid bed at any particular point under varying operating conditions—the effect of internal and/or external stripping of catalyst from cracked oil vapors — the effect of catalyst erosion on pipe bends of various contours — the life of various types of refractories used as interior vessel linings. Yes, these and numerous other studies are regularly undertaken in order to make the next Kellogg FLUID "Cat" just a little better than its predecessor —a little more profitable for its owner.

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER...

1 THE DEVELOPMENT "TOOLS"
—laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING
by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

3 SPECIALISTS IN EVERY PHASE
of design engineering due to the completeness of Kellogg's engineering staff.

4 SPECIALIZED BUYERS
backed by the cumulative buying power of the largest company in the business.

5 COMPLETE FABRICATING FACILITIES
to make schedule deadlines and to develop workable "firsts" in refinery equipment. The value of the former and its effect on construction costs is easy to understand. The second point is well demonstrated by the GIANT PIPE BENDER pictured here. Catalyst pipes on "Cat" Crackers are exposed to severe erosion. Ordinary segmented bends only increase the erosive action. To solve this problem, Kellogg shops created this exclusive device on which pipe up to 96 inches in diameter can be bent, providing a smooth interior contour that minimizes catalyst erosion.

6 CONSTRUCTION KNOW-HOW
acquired in completing hundreds of major jobs, plus an ample supply of the proper tools, and the constant development of new money-and-time-saving methods on the construction lot.

7 PRACTICAL OPERATING COUNSEL
on all design and construction, achieved through practical operating men working as an integral part of the company.

...AND ONLY KELLOGG HAS ALL SEVEN!

The M. W. Kellogg Company, (a subsidiary of Pullman, Inc.), New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris

VALVES ARE OPENED AND CLOSED *Automatically*..

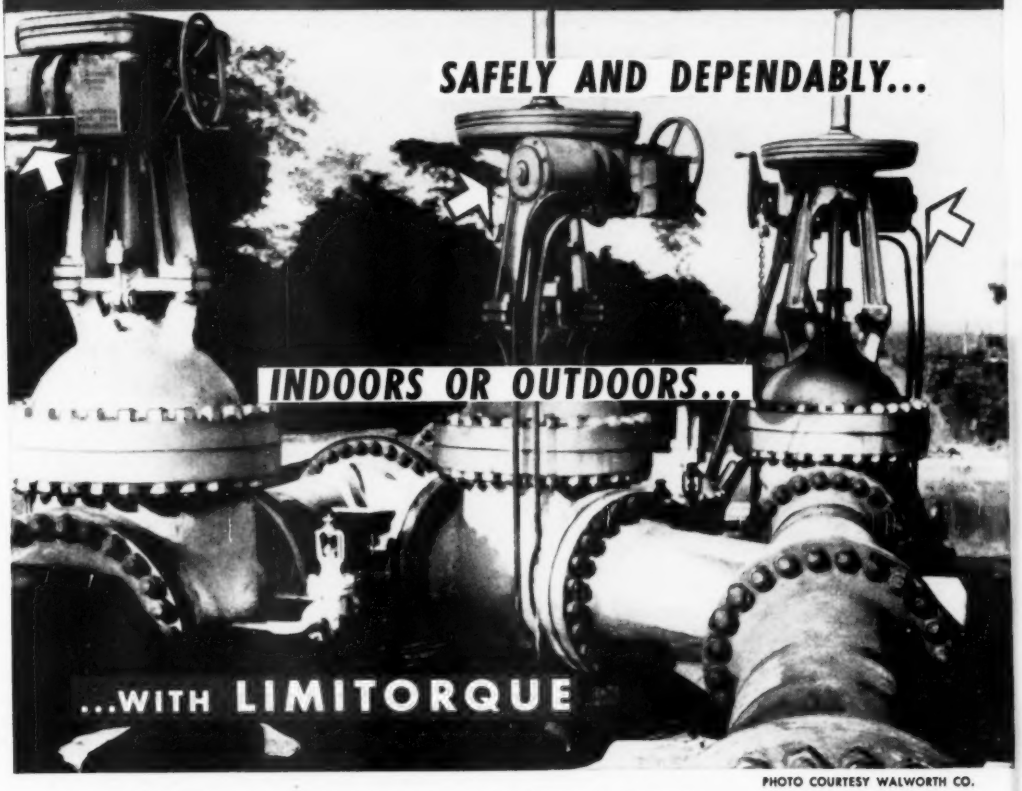


PHOTO COURTESY WALWORTH CO.

The above illustration was taken in far-off Venezuela, and shows 3 Electrically Operated *LimiTorque Valve Controls* mounted on 24" cast steel *Walworth* (series 300) *Valves*.

"LIMITORQUE" Operators are used on many pipe lines and in refineries throughout the world, because they operate (at the mere "push of a button") . . . under the most severe conditions of Heat or Cold, Rain, Snow, Dust, Dirt or Fumes . . . night and day . . . year-in and year-out—"LIMITORQUE" saves time, labor and money by *eliminating manual operation* of valves at distant locations. It opens and closes valves at the speed required, and is *absolutely dependable* and *safe*. As the name implies, "LIMITORQUE" limits the torque applied to valve operating parts and thus prevents damage to stems, discs and seats, etc.

"LIMITORQUE" utilizes any available power source for operation: electricity, oil, gas, water or air.

Please be sure to use your Business Letterhead when writing for this valuable 96-page illustrated Catalog.

Philadelphia Gear Works, INC.

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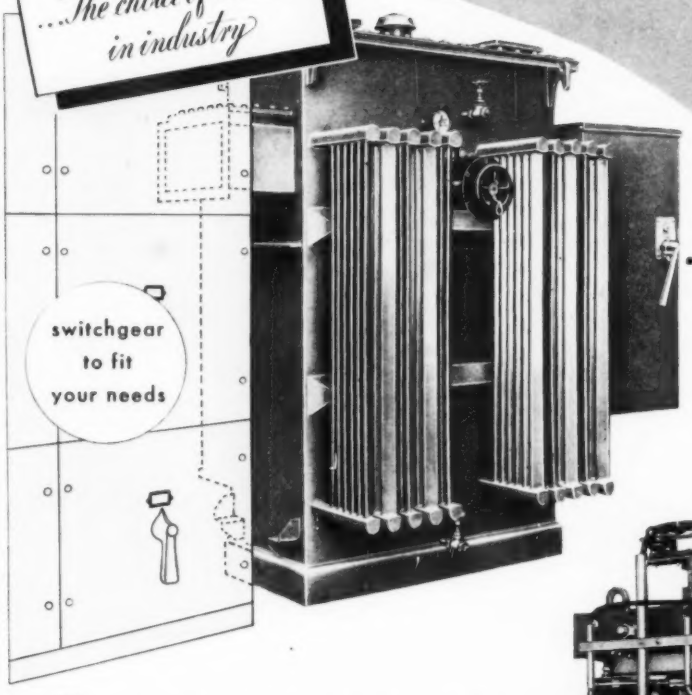
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

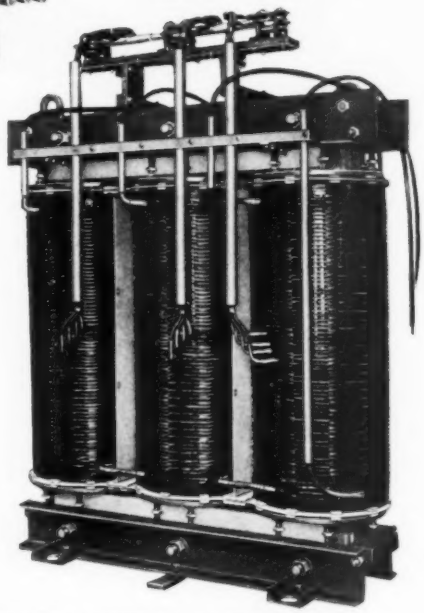
WAGNER TRANSFORMERS
...The choice of leaders in industry

Wagner Unit Substation Transformers

designed to meet your distribution requirements



Core and coil assemblies of Wagner unit substation transformers are designed by experienced engineers, and built and tested by skilled workers. Highest quality materials are used throughout, and meticulous attention to detail marks each step in their construction.



The transformer is the vital part of a load center distribution system. If the transformer fails, the entire system is dead whereas only part of the distribution system is affected by the failure of a switch or circuit breaker.

You can be sure of a dependable continuous flow of power from a Wagner transformer and you can be sure that it has been carefully designed to meet your distribution requirements.

Wagner unit substation transformers with incoming high voltage switch sections to meet your requirements, and with proper throats on the secondary side to connect to any make of switchgear, are available in the usual range of ratings up to 2000 kva. Our factory-trained sales engineers are well qualified to recommend the various combinations necessary to handle your unit substation requirements and they will be glad to give you immediate service.

Wagner unit substation transformers have been installed in all kinds of industrial plants including synthetic rubber, petroleum, steel, chemical, aircraft, automotive, paper, and many others. The importance of the transformer in a unit substation justifies calling in the Wagner sales engineer to help solve your load center problems.

Bulletins TU-13 and TU-56 describe the design and construction features that make Wagner liquid-filled and dry-type unit substation transformers outstanding.

WAGNER ELECTRIC CORPORATION
6389 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation
EST. 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

BRANCHES IN 29 PRINCIPAL CITIES

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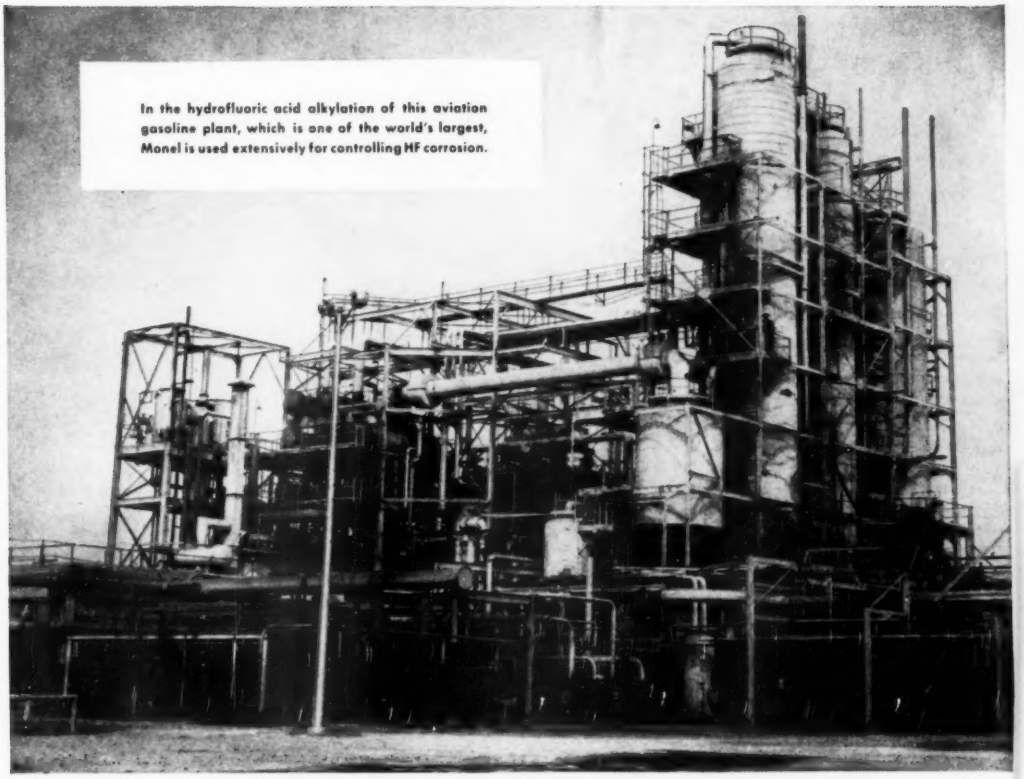


In the hydrofluoric acid alkylation of this aviation gasoline plant, which is one of the world's largest, Monel is used extensively for controlling HF corrosion.

Specify MONEL *for handling* HF *and* FLUORINE

Experience has proved that for maximum safety, and corrosion resistance, Monel® is among the most satisfactory materials of construction for handling fluorine and its more active compounds.

Monel is highly resistant to ignition by fluorine. It has been successfully used to handle fluorine at pressures up to 400 pounds per square inch, and has shown economical corrosion resistance at temperatures up to about 900°F.

Not only is Monel highly resistant to attack by fluorine, it also shows good corrosion resistance to anhydrous hydrogen fluoride and to steam-HF mixtures, even at temperatures as high as 1100°F. A proven practical application of these facts has been the established use of Monel in hydrofluoric acid alkylation units in petroleum plants.

In addition to these excellent chemical characteristics are Monel's well-known physical properties: high strength . . . easy fabrication and welding. Important too . . . Monel is readily available in all standard mill forms and fittings.

If your process requires the use of fluorine or fluorides, you will want to know more about Monel. For literature and additional technical data, write today.

EMBLEM OF SERVICE INCO TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

MONEL . . . for minimum maintenance

How much should a valve cost?

Only as much as is necessary for it to meet all the conditions under which it must operate.

When the service in which a valve is to be used requires special design and materials, it is poor economy to try to make an inexpensive valve do the job. "Down time", maintenance costs, if not actual valve failure, will far more than offset any initial saving.

On the other hand, in a majority of services, standard Powell Valves satisfy all requirements for long, trouble-free performance.

And, because Powell makes all kinds*, it is the soundest economy to standardize on Powell Valves for all your flow control requirements.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

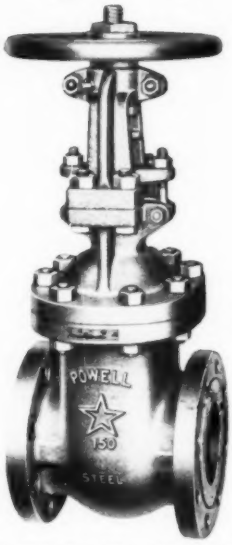


Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 375—200-pound Bronze Gate Valve. Screwed ends, inside screw rising stem, union bonnet, renewable wear resisting "Powellium" nickel-bronze disc.

Fig. 1460—Iron Body Bronze Mounted "Master Pilot" Gate Valve with screwed ends, rising stem, bolted flanged bonnet and tapered solid wedge.

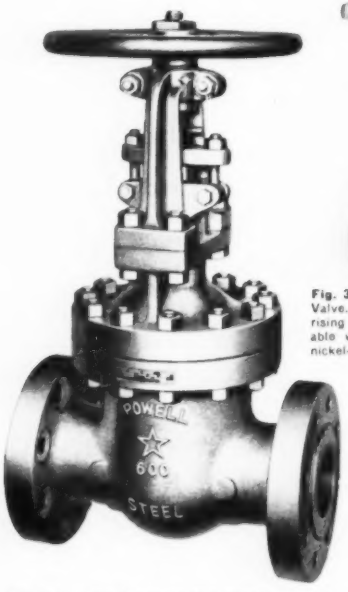


Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

***The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.**

Ask your nearest Distributor—or write direct

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

WHY, THE MAN HAS HOLES IN HIS HEAD!

You can't protect yourself against a mid-winter storm with a light summer suit . . . and you can't protect your fuels and lubricating oils with inadequate filters. It's as simple as that. Yet, there are some men who try. They try because they think they can save a few pennies, but instead of making a saving, sooner or later they lose their shirts . . . right out from under their linen suits.

When you're in the market for filters . . . it pays to ask a few questions. How much dirt will the filter actually stop? After it stops the dirt, can the filter hold it? Is the element designed to filter really *dirty* oil, or just *clean* oil? Is the element designed so that its surface will continue to provide efficient filtration over a reasonable period of time, or will it quickly become clogged and coated and cease to serve its purpose? Is your particular job adequately performed by just one filter, or should it require more than one? And last but not least, are you getting the *right size* filter to give your equipment sufficient protection?

Winslow elements are built to filter *dirty* oil, to eliminate *the dirt that hurts*. They aren't laboratory filters. They are filters built for hard, day-after-day service in actual operation. They save you *dollars*, not *pennies*.

Winslow Filters eliminate the largest particles of dirt first, and then progressively catch and *hold* smaller particles as the oil passes inward toward the center core. There is no premature clogging, no buckling of the element, allowing dirty oil to by-pass it.

If you are interested in complete safety and satisfaction, with lasting economy, write to Winslow today for further details.

WINSLOW FILTERS

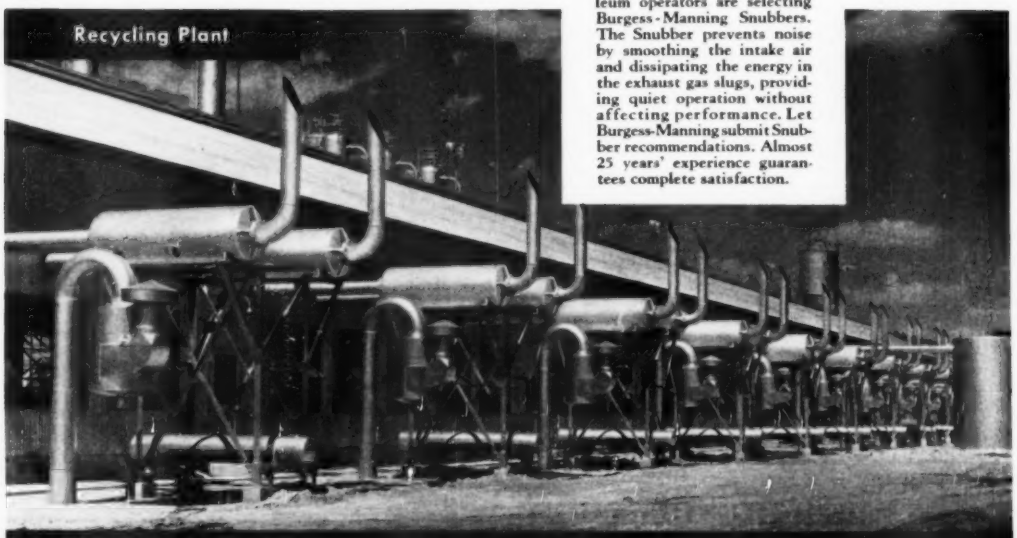
AD W-502

Winslow Engineering Company **4069 Hollis Street • Oakland 8, California**

Snub the Slug—and Stop the Noise

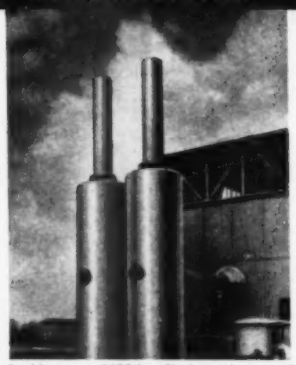
FROM ENGINE EXHAUSTS AND COMPRESSOR INTAKES

Wherever noise from internal combustion engines, compressors, blowers, vacuum pumps, cannot be tolerated; where flying sparks must be eliminated; for surge control in gas and air piping, petroleum operators are selecting Burgess-Manning Snubbers. The Snubber prevents noise by smoothing the intake air and dissipating the energy in the exhaust gas slugs, providing quiet operation without affecting performance. Let Burgess-Manning submit Snubber recommendations. Almost 25 years' experience guarantees complete satisfaction.



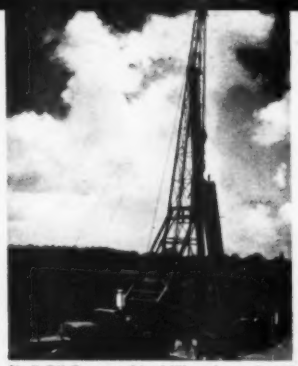
Recycling Plant

Main Line Gas Booster



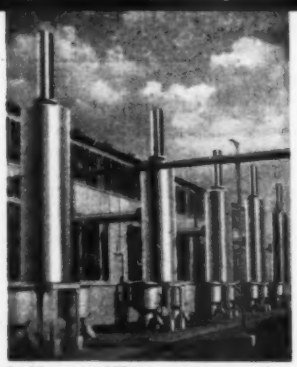
Snubbers on 1600-hp Clark engines used on a main line gas booster station.

Portable Drilling Rig



Shell Oil Co. portable drilling rig equipped with a Snubber.

Pipe Line Compressing Plant



Snubbers on 800-hp compressor engines of the Panhandle Eastern Pipe Line Co.

For Quiet Telephoning—Use Burgess-Manning Acousti-Booths

You can hear easily . . . talk comfortably . . . in a Burgess-Manning Acousti-Booth, even with intense noise. Thick walls of sound-absorbent material soak up noise. Airy, easily moved, sturdy construction.

INSTALLATIONS—

- Stationary and portable internal combustion engines
- Steam discharge
- Positive displacement and reciprocating vacuum pump discharge

APPLICATIONS—gas transmission · repressuring · recycling · refineries · gasoline plants · drilling · oil well pumping · crude oil and product pipe lines.

BURGESS-MANNING COMPANY

LIBERTYVILLE, ILLINOIS

New WHELAND HP-14000 7½" x 14"
Duplex Slush Pump

STEEL OR SEMI-STEEL FLUID END OPTIONAL

350 Horsepower

...AND ALL THE HORSES ARE THERE!

WHELAND TIE RODS. Maximum strength, minimum weight. Tie rods for extra strength are used by leading manufacturers of heavy-duty equipment such as big hydraulic and mechanical presses for forging, stamping, bulldozing. No better method has ever been found to get strength where it is most needed. Wheland uses tie rods because it is the BEST WAY to get EXTRA strength into a pump. You may have seen a lot of pumps broken in the cradle . . . but YOU NEVER SAW A WHELAND TIE ROD PUMP WHICH BROKE AT THE CRADLE.

From discharge pressure of 838 lbs. with 7½" liners to 1627 lbs. with 5½" liners at 60 R.P.M., here is the pump that delivers the mud. Wheland's exclusive power end has the strength to do the job. The fluid end, available in steel or semi-steel, is one of the best liked, best proved designs ever offered the oil driller.

This new Wheland pump is packed with features that mean extra strength, extra smoothness, more accessibility, more flexibility and great DEPENDABILITY. It's your best buy in pumps! Write for bulletin or

Ask the J & L Man

THE BEST POWER END EVER BUILT

The crank is the guts of any pump and here is the outstanding development . . . EXCLUSIVE WITH WHELAND. Assembled as an integral unit with NO CONNECTING ROD BOLTS. One-piece alloy steel crank on Timken Roller Bearings. Heat treated alloy steel connecting rods fitted to crank on American Roller Bearings. Tool steel helical gear and pinion, specially hardened. Ample size. Ample strength. Quiet. Free of vibration. This WHELAND pump really has the guts to do the job!

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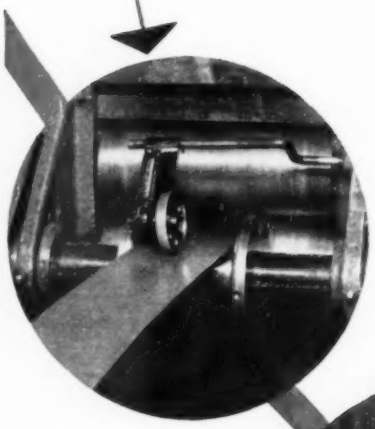
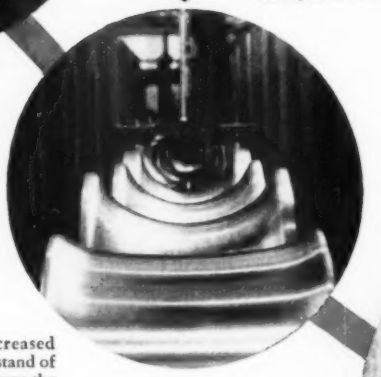
DRAW WORKS • SLUSH PUMPS • ROTARIES • SWIVELS • CROWN BLOCKS • TRAVELING BLOCKS

BEFORE... *and* AFTER...

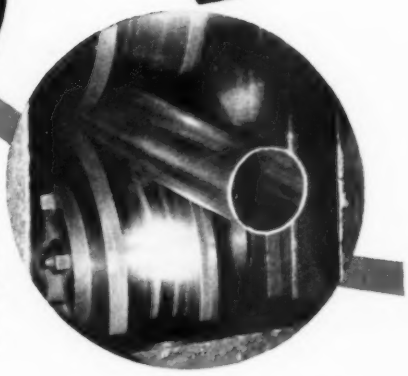
Republic ELECTRUNITE Pressure Tubes are made from highest-quality flat-rolled steel, both sides of which are thoroughly inspected before being formed into tubular shape. Thus, the inner surface of every tube is free from scabs, slivers, rolled-in scale and scale pits.



In the ELECTRUNITE Process, clean flat-rolled steel—*always of uniform thickness*—enters the first in a series of cold-forming rolls . . .



. . . in which increased curvature in each stand of rolls gradually forms the flat steel into uniformly round tubular shape . . .



. . . after which it is welded by Republic's improved electric resistance welding process, and emerges in the form of uniformly strong, sound tubing.

ELECTRUNITE PRESSURE TUBES ARE

Clean···Scale-Free

INSIDE AND OUT

THE very nature of the modern ELECTRUNITE PROCESS means that there's a big difference between Republic ELECTRUNITE Pressure Tubes and those made by other methods of manufacture.

In the ELECTRUNITE Process, highest quality flat-rolled steel is cold-formed into shape and electrically welded into strong, sound tubing. *Careful visual inspection* of the flat surface which becomes the inside wall of each tube provides positive proof that there are no hidden defects or trouble-inviting pits in the wall. Each length of ELECTRUNITE Tubing is smooth and clean, *inside and out*—uniformly strong and sound throughout its entire length.

Yet, thorough visual inspection is but one of the many rigid testing and inspection procedures which are a vital part of the ELECTRUNITE Process. Expansion tests . . . crush tests . . . hydrostatic pressure tests . . . all combine to give you the fullest possible assurance of dependability and satisfaction when you use ELECTRUNITE—the *original* resistance welded Pressure Tube.

For complete information, including a list of sizes, gages and analyses—or prompt technical assistance on a specific tubing problem, write, wire or phone *today*.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

You ordered this finer Gauge!

You asked for pressure gauges that would stay accurate under the unequalled punishment of oil country service.

Our answer was the Marsh Mastergauge series—gauges with the rugged bourdon tube and the heavy-duty precision movement built to withstand the extremes of pressure, temperature, pulsation, vibration.

Today thousands of Marsh Gauges throughout the oil industry prove that we found the *right* answer. You ordered this finer gauge. It is ready for you at your local supply store.

MARSH INSTRUMENT CO.
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This Oil Industry Bulletin is yours for the asking

The Marsh branch plant at Houston offers shipment from stock and facilities for repairing all makes of gauges.

MASTERGAUGE—the all-purpose gauge for toughest applications. Guaranteed accurate within ½ of 1% of reading.

CHRISTMAS TREE GAUGE—a gauge that incorporates ruggedness and accuracy beyond all others.

OIL COUNTRY BOILER GAUGE

MARSH STOCKED by Your Local Supply Store **GAUGES**

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SINGLE RESPONSIBILITY CONTRACT
includes . . .

- DESIGN
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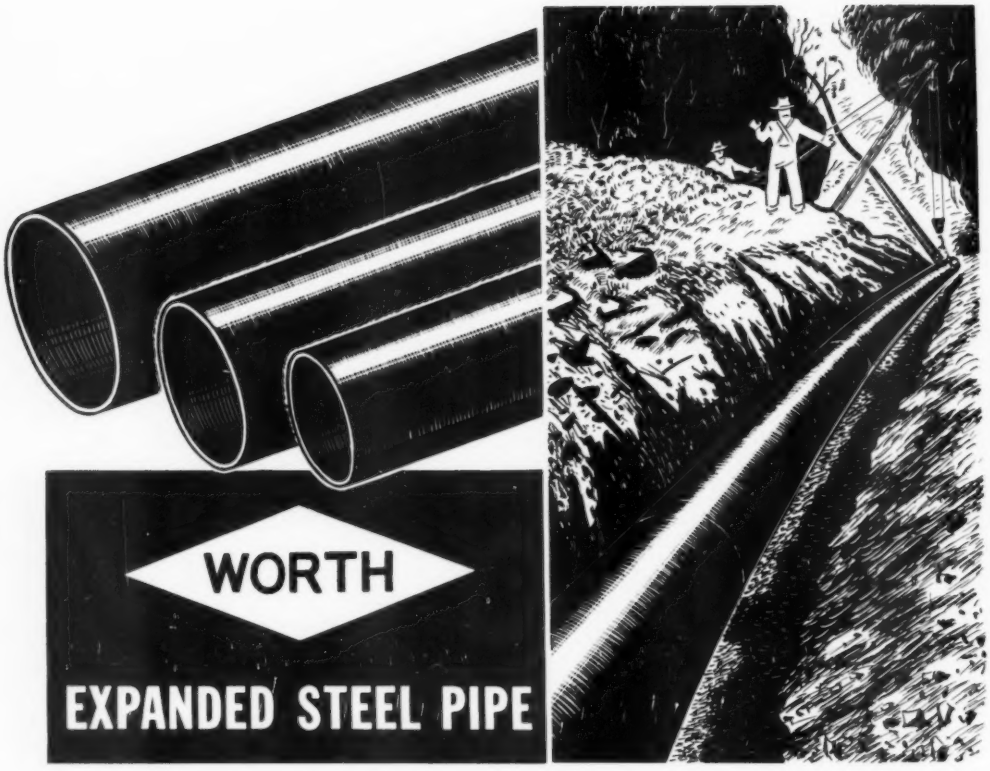

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. . . because it is held to close tolerance dimensions, toughness and yield strength to provide faster and easier fitting-up, bending and welding.

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WORTH STEEL COMPANY • Claymont, Delaware

CUT YOUR TANK VENTING costs

WITH THE NEW "VAREC" FIGURE 2000 CONSERVATION VENT VALVE

FEATURES

1. **Lightweight and Small** for low cost and easier handling.
2. **Venturi Inlet** for high flow capacity.
3. **Hyperbolic Pallets** for streamlined flow.
4. **Center and Side Pallet Guiding** — eliminates pallet sticking.
5. **Readily Accessible Pallets** through small top cover, no heavy deflector cover to remove.
6. **Valve Seats Regrindable** in place or easily removed.
7. **Easily Replaceable Valve Seats** — metal-to-metal or non-metallic.
8. **All Aluminum Construction** for H_2S corrosion resistance or semisteel construction as required.
9. **Standard Flange Connections** for flame arrester or tank nozzle.
10. **Emergency Flame Snuffer** if desired.
11. **Wide Range of Pressure and Vacuum Settings.**
12. **Complete Range of Sizes** from 2" to 12".

Now, "VAREC" offers you smaller and lighter vent valves that do a better job than larger heavier valves and cost less per thousand cubic feet of tank venting. These new lightweight, low cost Figure 2000 Vent Valves apply the proved theory that the incorporation of a venturi in the valve design greatly increases the flow. In fact, when mounted on a standard nipple, the flow exceeds that of the nipple alone. Certified flow curves are available.

This principle with regard to the design of vent valves was discussed in advertisements of the Vapor Recovery Systems Company several years ago. Further study resulted in the present design of the Figure 2000 Valve, utilizing hyperbolic pallets and the additional advantage of raising the venturi throat diameter further into the valve. This decreases overall valve size and weight without decreasing port diameter to a point where valve efficiency is materially affected.

PROVED and APPROVED "Varec"

We invite you to compare size for size valve flow under similar testing conditions and then compare weights and prices. Use the coupon to send for a copy of "Lowest Cost per 1,000 cu. ft. of Tank Venting."

THE VAPOR RECOVERY SYSTEMS COMPANY

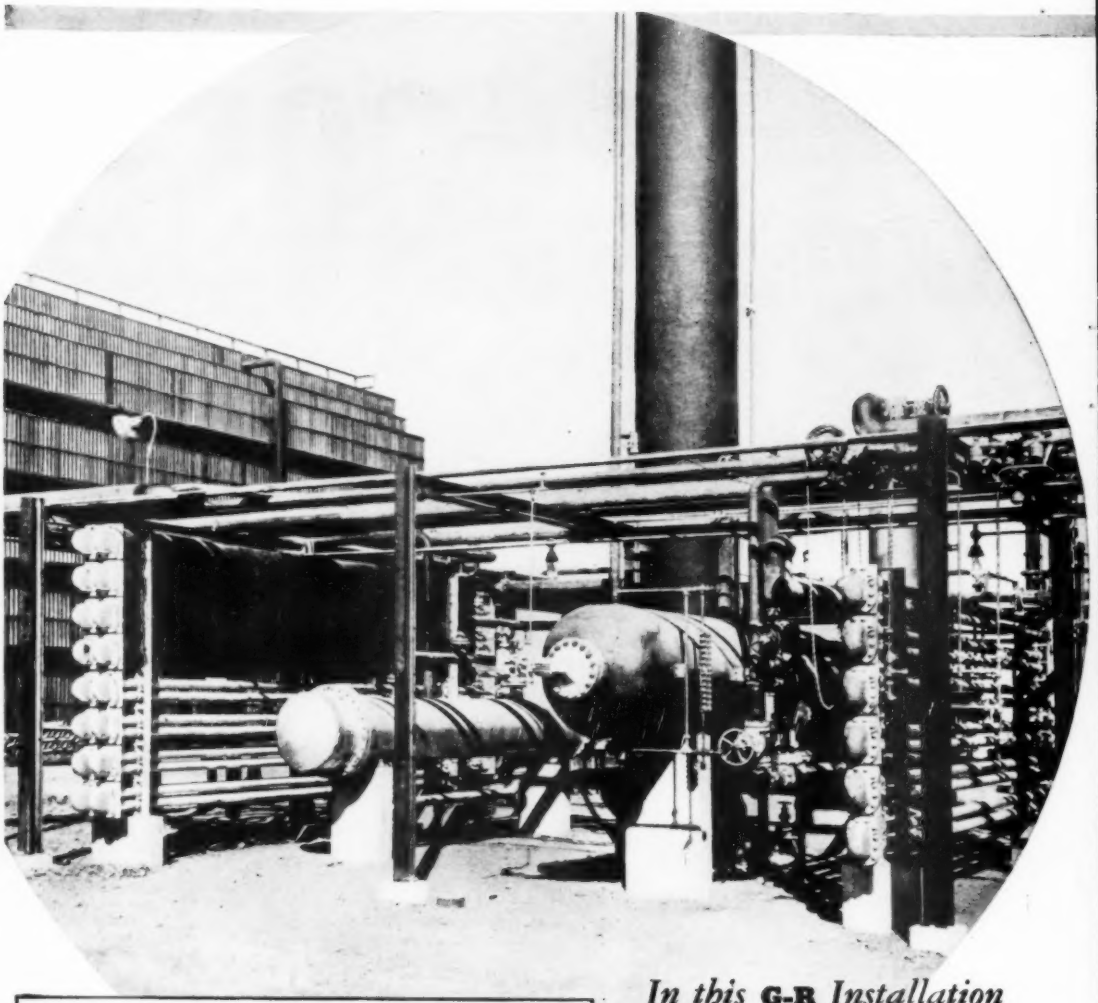
NEW YORK • PITTSBURGH • CHICAGO • TULSA • HOUSTON
COMPTON, CALIFORNIA, U.S.A.

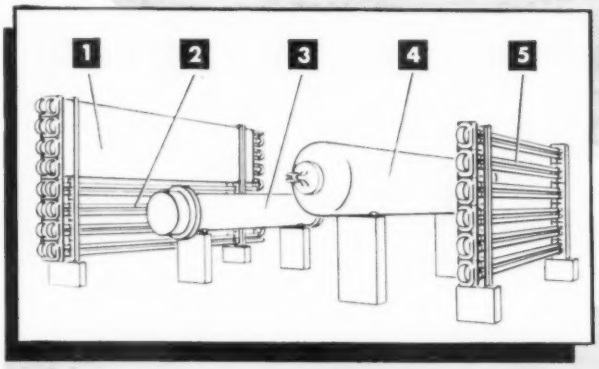
"Varec" CONSERVATION VENT VALVES and UNITS

P-13

THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA
Dept. O.G.J.

Name _____ Title _____
Company _____
Street and No. _____
City and State _____





In this G-R *Installation*

1. 8 G-R Twin G-Fin Sections, serving as Stabilizer Exchanger
2. 8 G-R Twin G-Fin Sections, serving as Stabilizer Cooler
3. G-R Type FLT Tubular Stabilizer Condenser
4. G-R Type FSE Stabilizer Reboiler
5. 6 G-R Twin G-Fin Sections, serving as Naphtha Side-Cut Cooler

GRISCOM-RUSSELL · PIONEERS IN HEAT TRANSFER APPARATUS

G-R

HEAT TRANSFER APPARATUS Fully Serves a Stabilizer In This Installation

As shown in the illustration on the adjoining page, all the heat transfer apparatus required for the stabilizer at this representative refinery is of G-R design. The G-R units include cooler, exchanger, reboiler and condenser, and also naphtha side-cut cooler.

Many additional G-R units, not shown in the illustration, were also installed for other services here; for this refinery, like hundreds all over the country, standardized on G-R Heat Transfer Apparatus to assure most effective heat exchange and recovery throughout the plant.

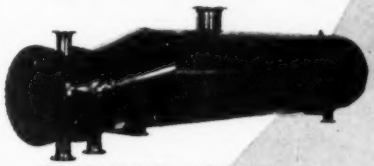
Whatever may be *your* heat transfer requirements . . . whether standard or special . . . investigate G-R designs. The unequalled range of G-R apparatus, including both finned tube and bare tube heat transfer surfaces, provides an exactly suitable design for every service. Write for descriptive bulletins on units for services in which you are interested.

THE GRISCOM-RUSSELL CO.
285 MADISON AVE., NEW YORK 17, N. Y.

TYPICAL DESIGNS OF G-R HEAT TRANSFER APPARATUS

G-R Tubular Exchanger, available with many different designs of stationary and floating heads, and with exclusive service features

Sectional drawing of the G-R Twin G-Fin Section, the heat exchanger with a greater range of applications than any other design on the market



One of the designs of G-R Reboiler, available with bare tubes or K-Fin elements.

GRISCOM-RUSSELL

THE Armstrong hardened chrome steel valve opens wide and closes tight — with a snap! This eliminates throttling and consequent wire drawing. The Armstrong free-floating lever mechanism is almost frictionless. The bucket and valve lever assembly are 18-8 corrosion resistant stainless steel. The mechanisms of Armstrong steam traps for low and medium pressures are identical in materials and workmanship to those used in Armstrong traps for pressures to 1500 psi, 900 F.

There is nothing in an Armstrong trap to bind, stick, collapse or leak. *Now is the time to quit working for your steam traps and buy the traps that will work for you.* Call your nearby Armstrong representative today.

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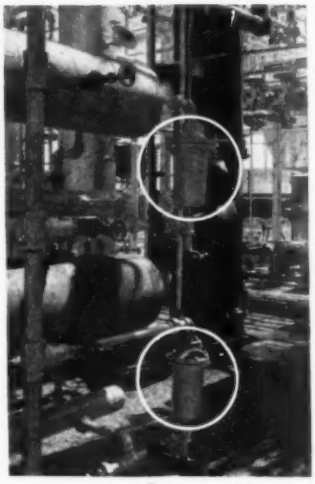
868 Maple St., Three Rivers, Mich.

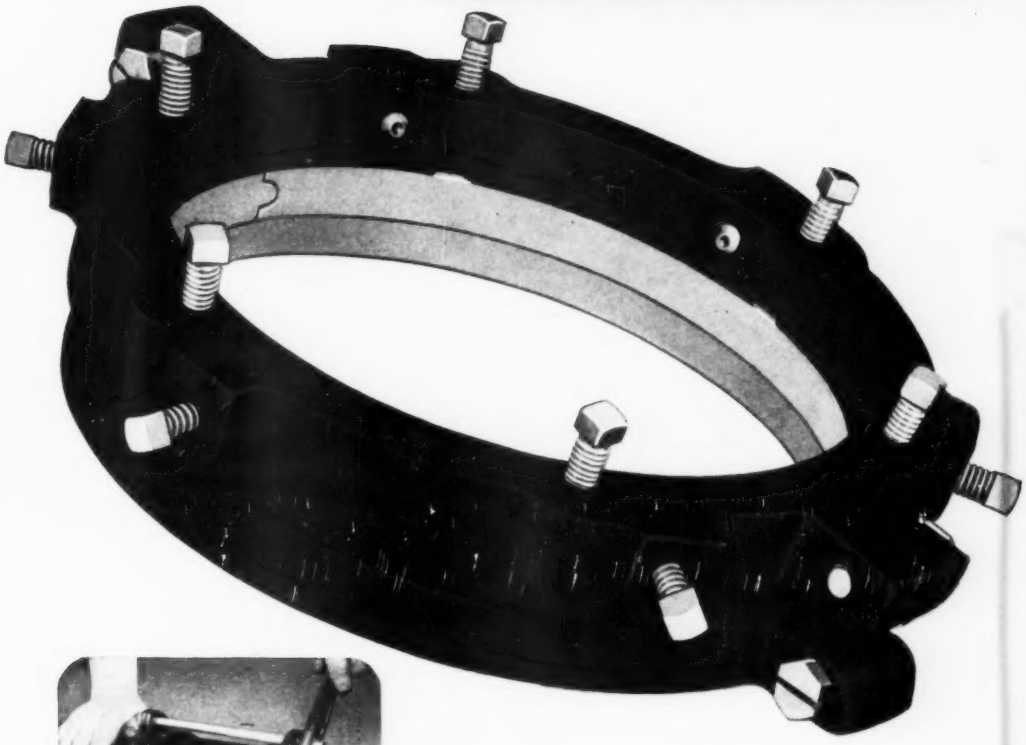


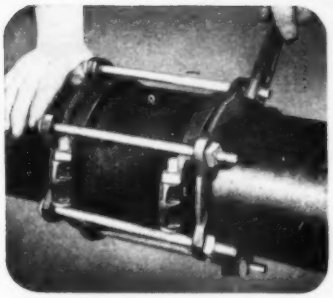
THE 36-PAGE ARMSTRONG STEAM TRAP BOOK contains complete data on the design, operation, selection and installation of Armstrong steam traps for all services. Send for your free copy.

SEE OUR CATALOG IN SWEET'S

ARMSTRONG STEAM TRAPS

FOR THREAD LEAKS AT FITTINGS





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SKINNER-SEAL COLLAR LEAK CLAMP, with its sealed gasket and massive construction, stops every type of collar leak.

SKINNER-SEAL PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into a fitting. Any temperature — pressures up to 2,000 pounds. A permanent repair — it saves the cost of tearing out and renewing leaky fittings. Prevents shut-downs. In universal use for over half a century. In stock at all Oil Well Supply Stores!

M. B. SKINNER COMPANY, SOUTH BEND 21, IND., U. S. A.

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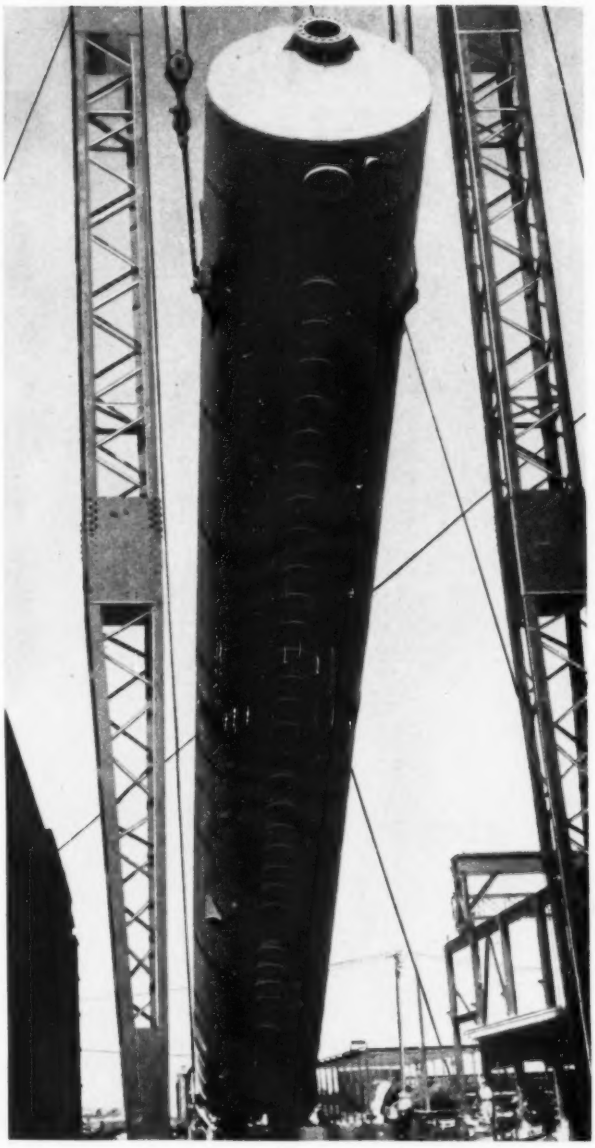
MADE-TO-ORDER UNITS

for Petroleum and Chemical Processes

If you are a prospective purchaser of any such units, you will profit by consulting with Sun Ship. Here you have the benefit of long experience, exceptional skills and unlimited facilities. These facilities include our favorable location, because of which we can ship by water all units too large to be transported by rail . . . Also, the Sun reputation for building, reconditioning or repairing tankers and cargo vessels warrants your consideration when planning the overhauling or expansion of seagoing transport equipment.



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SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

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25 BROADWAY • NEW YORK CITY

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

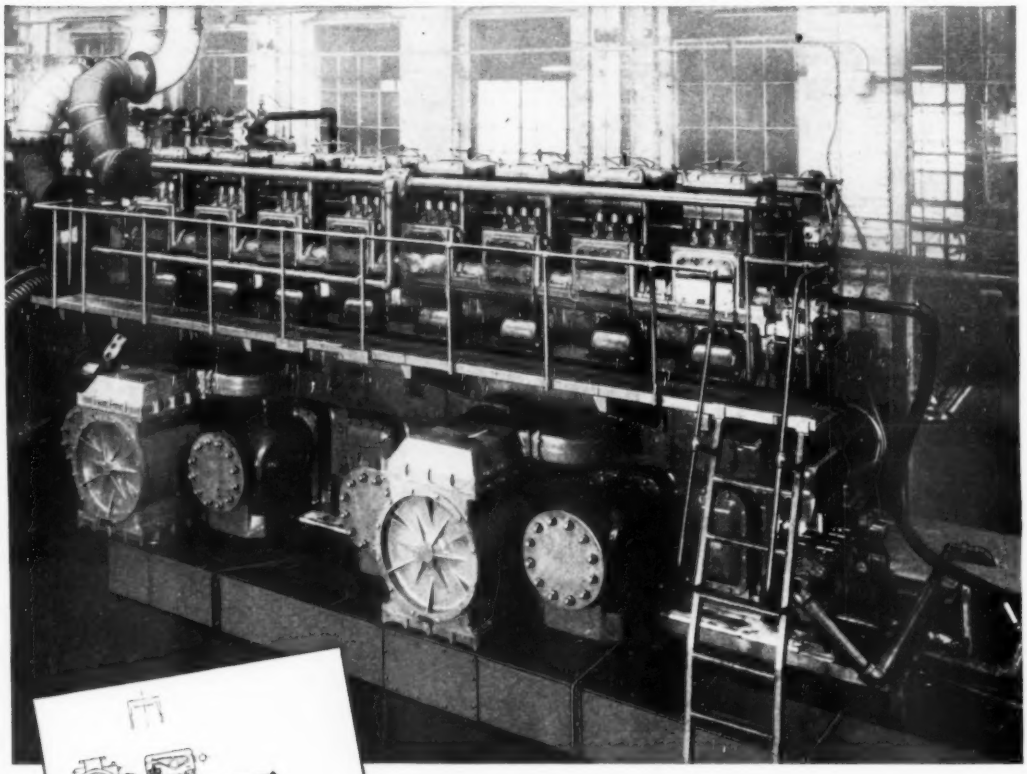
Desired delivery temperature automatically maintained.

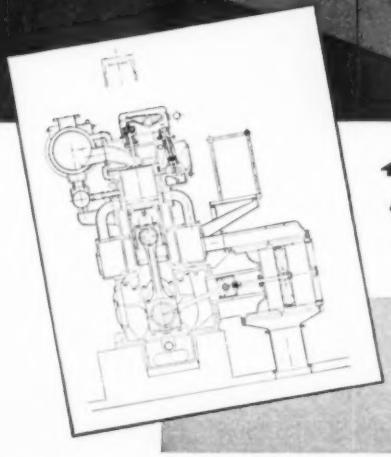
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
322 WILSON, SO. NORWALK, CONN.

BRAND





A unitlo UTC-168 on the test block.

Section through engine and scavenging pump, showing 360° intake ports and the mechanical exhaust valves.

WORTHINGTON

NEW...

and 11 ways better!

Worthington Achieves a Triumph in Modern Angle Gas Engine Compressor Design with the Uniflo TYPE UTC-16's...Thru-Scavenging, 2-Cycle Engines of 800—2,000 HP that Hit New Highs in Efficiency AND Economy...Outstanding on Pipeline Duty

1. UNIFLO SCAVENGING — A RADICAL IMPROVEMENT OVER CONVENTIONAL LOOP SCAVENGING.

AIR PORTS AROUND ENTIRE CIRCUMFERENCE OF CYLINDER. Port area more than double.

EXHAUST THRU CAM OPERATED TIMED VALVES IN CYLINDER HEAD. Area 50% greater.

STRAIGHT LINE AIR FLOW thoroughly cleanses and cools entire cylinder.

SUPERCHARGING. Timed valves retain greater weight of pure air for perfect combustion.

THESE IMPROVEMENTS result in higher mean effective pressures without increased temperatures.

2. EN BLOC FRAME—permits use of removable cylinder liners.

3. DOUBLE AIR MANIFOLDS—doubles volume of air and steadiness of flow.

4. RENEWABLE CYLINDER LINERS — mean longer life and low-cost maintenance.

5. PISTON—completely symmetrical outer piston wall — wrist-pin supported in separate carrier.

6. CYLINDER HEAD — Worthington cone-type ... two large exhaust valves — streamlined passages.

7. GEAR DRIVEN CAMSHAFT—assures positive drive and perfect timing.

8. IMPROVED COOLING — jacket water space cast integral with liners, eliminating internal water seals.

9. LUBRICATING SYSTEM—Worthington cast-in manifolds, positive pressure lubrication to every running part.

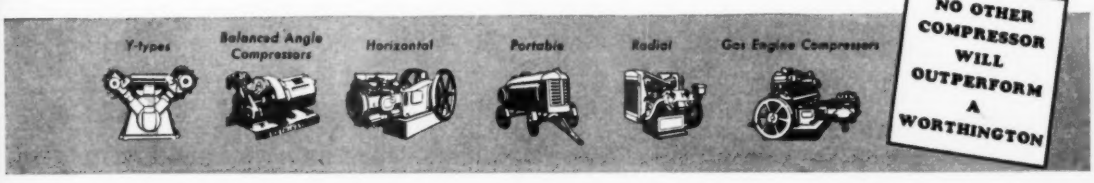
10. ACCESSIBILITY — inherent in straight-line engine design, increased by large access doors on both sides of the engine frame.

11. WORTHINGTON FEATHER* VALVES: lightest, tightest, quietest ever made used in both compressor and scavenging cylinders.

"CUSTOM-BUILT" FOR ITS JOB

In addition to Worthington's experience covering half a century of building compressors for pipeline duty, more than seven years of intensive research devoted to developing the uniflo scavenging principles have gone into producing the TYPE UTC-16. The result is an Angle Gas Engine Compressor that meets the rigid requirements of gas pipeline service with more efficient use of fuel, cooler operation, improved accessibility and longer service life. For further facts about the uniflo TYPE UTC-16 — and proof that here, again, *there's more worth in* WORTHINGTON — contact your nearest Worthington Branch Office or the *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

*Reg. U. S. Pat. Off. EK.0.1



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It's a "package proposition" when Graver Construction Co. handles the job. Everything is included—engineering and planning . . . labor and materials . . . field equipment and tools . . . supervision and inspection. For complete service under one responsibility, call on Graver!
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A DIVISION OF GRAVER TANK & MFG. CO. INC.
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They Say—

Recycle Solution

Sir:

Your editorial in the March 9 issue and the lead article on page 47 ("Recycle Gasoline," by John C. Casper) point up a recurring source of weakness in the refined markets; the direct marketing of motor fuel of a sort from natural-gasoline and cycling plants.

The solution suggested near the end of your editorial has merit: the absorption of the output by refiners and its disposal by refineries in normal market channels. I am not sure that this will cure the situation because the investments for producing finished products are made, but it should make unlikely the further aggravation of the situation by the conversion or installation of new facilities. . . .

It seems to this writer that "top" executives of integrated companies which produce condensates in the field should examine into the disposition of these light ends. . . . If they find that their field operations affect the profitability of another department, they have it in their power individually to make such policy changes as each sees best to fit his particular case. This is no situation for running to the authorities (crying in the wilderness, generally) but one for the exercise of individual responsibility by those affected, where that is possible. And the time is urgent.

What is suggested is no "cure all," but it might be helpful. Many plants . . . will be obliged to continue the extant operations. A new conversion process promising quality equal to refined gasoline, including "high-jump" octane, will encourage the larger plants or a group of plants in a concentrated area to remain in the motor-fuel business. At the same time, the quality improvement should deter price selling. This development may, on balance, be constructive. There is no cure-all in this industry. Who would want it if there were?

Emby Kaye, Tulsa.

Imports and Congress

"Imports are being brought into the United States by only a few companies. Six companies bring in about 80 per cent of all imports. The record shows that these companies are indifferent to the elimination of the independent oil man in the United States.

"These companies already hold a monopoly in foreign areas and it is clear that unless stopped by law their present course will lead to a monopoly of the domestic industry. The

OKADEE butane-propane VALVES

Okadee Valves have the perfect seal for butane, propane, and other hard-to-hold light fluids and gases. Their precision lapped seats and discs assure complete and positive shut-off. One-quarter turn fully opens or closes the valve. Being non-lubricated, they require no maintenance or service.

Where fast, full opening and closing is essential . . . where leak-proof shut-off is paramount, such as on this butane - propane loading rack in a Gulf Coast refinery, Okadee Valves are the perfect installation.

Ask your WECO Representative or write for catalog for complete details of OKADEE VALVES.

EASY OPERATING

POSITIVE SEAL

NON-LUBRICATED

LONG LIFE

WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
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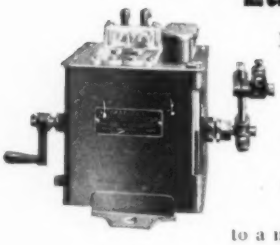
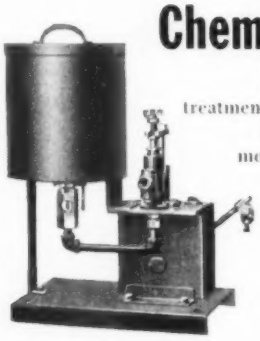
WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

Lubricators



Manufacturers serving the world-wide petroleum industry standardize on Manzel Force Feed Lubricators to make sure users of their machinery will receive long, economical, trouble-free service. Manzels supply all wearing parts with just enough of the right lubricating oil...cut labor costs to a minimum...reduce oil consumption to half that of hand feeding...prevent costly breakdowns.

Chemical Feeders



In pipe line, oil tank and bottom hole treatment, the various chemical compounds are automatically introduced in accurately measured quantities by Manzel Chemical Feeders. Sturdily built and simply designed, these feeders have an unsurpassed record for dependable, trouble-free operation.

Be sure to specify *Manzel* on your next installation...and write for helpful information about obtaining Manzels for your present equipment.

Manzel, Inc. now supplies repair parts for all models of Bowser and Torrington Lubricators.

Builders of HIGH PRESSURE METERING PUMPS Since 1898

Manzel INC.

336 BABCOCK ST., BUFFALO 10, N. Y.

nation's security requirements for oil and our peacetime consumer needs will then be at the mercy of a combine of a few large companies operating throughout the world.

"The Secretary of Defense has endeavored to reduce the terrific tax burden of maintaining a standing army sufficient to defend our country against any aggressive action, but he has done so on the assumption that the direct tax burden could be avoided only by the maintenance of a strong industrial army to be readily available.

"Oil is a most essential element of our industrial army.

"Imports of foreign oil at the current excessive rates presents a national problem and one that only Congress can solve.

"Congress must not permit foreign oil to bring about unemployment. It must not permit foreign oil to displace the source of revenue essential to the maintenance of our government.

"And above all it must not permit imports to jeopardize our security by letting us become dependent on foreign oil."

Sen. Elmer Thomas, upon introducing bill to limit imports.

Abundance Means Competition

"The oil industry can be justly proud of a job well done in creating a reserve capacity which would be of vital importance to our nation's security in periods of emergency. The existence of such capacity assures a plentiful supply of crude oil and refined products at all times. On the other hand it may create, from time to time, conditions of oversupply and hence is conducive to highly competitive markets. . . .

"The year 1950 promises to be a period of . . . intense market competition. The growing availability of crude petroleum relative to demand may exercise an increasing pressure on crude prices. In the refined products markets further moderate price declines may be anticipated. . . ."

L. F. McCollum, president, and James J. Cosgrove, chairman of the board, in Continental Oil Co.'s annual report.

Geological Reintegration

"The multiplication of specialized societies during the past few decades was essential to the development of science and technology in this country; but it also meant a loss of contact between specialists in different fields and between scientists and the general public. To offset these effects of unlimited specialization, a new movement of reintegration is now stirring in all major scientific fields.

"The foundation of the A.G.I. (American Geological Institute) is a part of this new movement. One may hope that from this integration of related fields will come a renais-

sance of the geological sciences. Already an optimist can catch glimpses of new viewpoints and objectives taking shape from the cross-fertilization of ideas between and among paleontologists, mineralogists, geologists and geophysicists, on the one hand, and biologists, chemists, and physicists on the other.

"The A.G.I. embodies . . . our realization that all of us, geophysicists, mineralogists, geologists, and paleontologists, whether economic or academic, are alike concerned with problems of the earth, its constitution, and its history."

William W. Rubey, president, Geological Society of America, writing in A.G.I. News Notes.

New Market

"It has been estimated that service refills of automatic transmission fluid will average about 25,000,000 gal. for each of the next 5 years, and they are expected to reach 60,000,000 gal. by 1960. . . ."

The Orange Disc, the Gulf companies.

No Commonplace Job

"The oil industry, second only to farming in value of its products, is assuredly destinated for a future at least as bright as its past. There has been much talk of oil reserves being depleted in only a few more years. At this time, known domestic reserves are equivalent to no more than 15 years at the present producing rate; however, it should be kept in mind that much oil is being found each year and remains to be found.

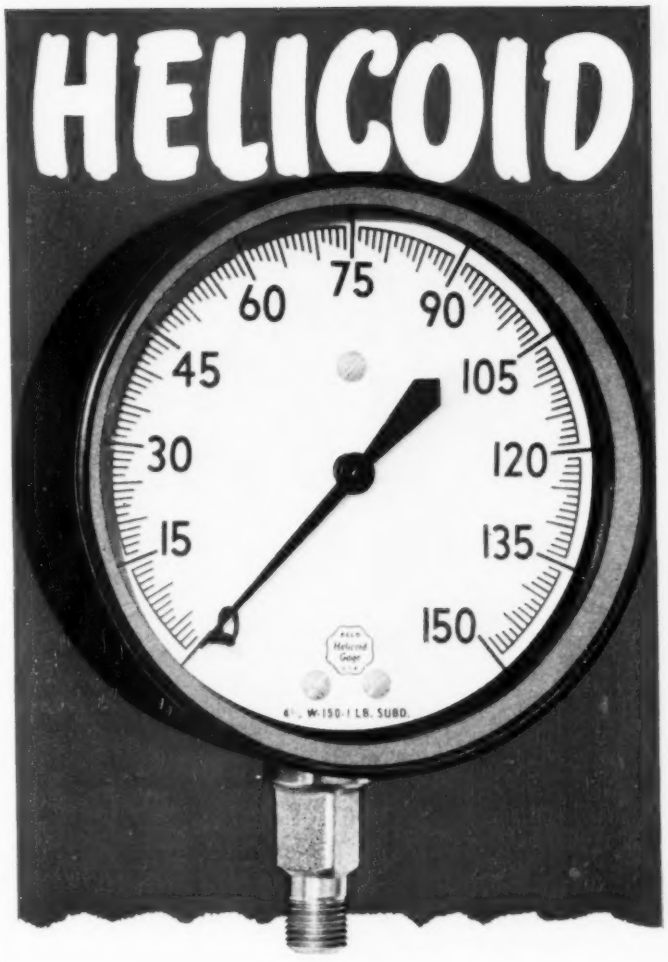
"By its very nature, the finding and production of crude oil can never become commonplace. The oil men of the future, must demonstrate the same spirit of adventure as did your forebearers under circumstances fundamentally similar. . . ."

J. R. McWilliams, executive vice president, Carter Oil Co., addressing Annual Career Conference, University of Oklahoma.

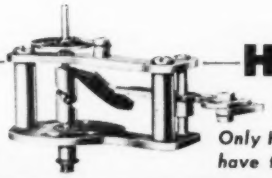
Threat to Stability

"Whereas the year 1948 saw crude-oil supply brought in line with demand, in 1949 there developed a condition of oversupply, caused largely by mounting foreign imports at the expense of our domestic oil economy. Reduced production allowables, chiefly in Texas, were the inevitable result, with consequent decline in sales volume and earnings. A continuance of this trend will place in serious jeopardy the independent producer, whose contribution to the development of the oil business has been outstanding. Further, the maintenance of adequate price for crude is indispensable to healthy development and the search for new production and reserves."

Annual report of Texas Gulf Producing Co.



• *The greatest improvement in pressure gages in 100 years. Write for HELICOID GAGE CATALOG.*



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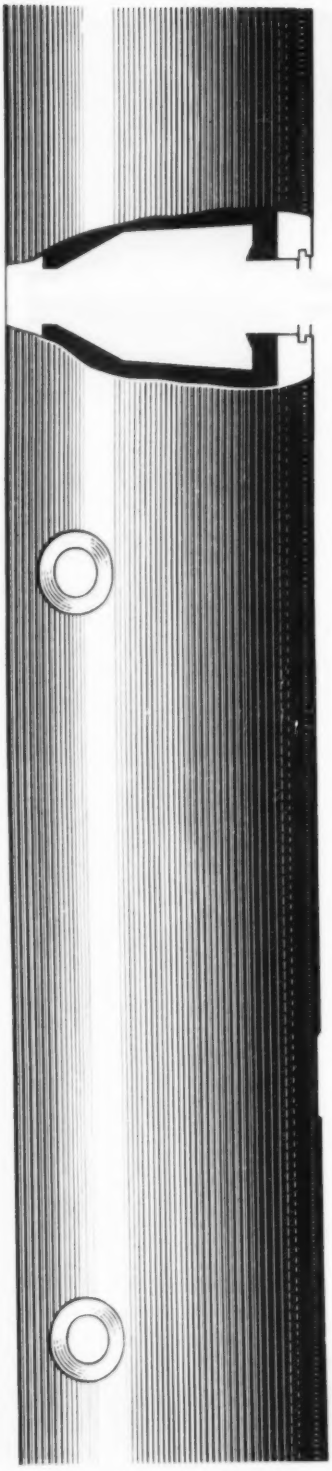
Only Helicoid Pressure Gages have the Helicoid Movement

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut

TRADE MARK



How WELEX JETS Cut Perforating Costs!

Many well operators who have compared costs carefully can tell you that Welex Jet perforating has saved them money. One of the big reasons is that Welex gives you *deep, clean penetration with every shot. You get more production per hole.*

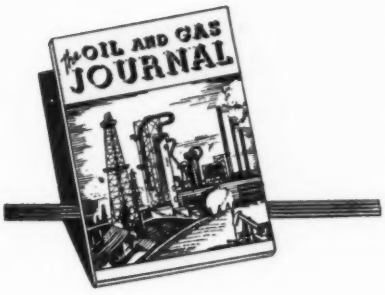
When you order casing perforating, it is *penetration* for which you are paying. Jets give you 300% greater *penetration* . . . . plus . . . . the cost-cutting efficiency of highly skilled perforating crews trained and supervised by the men who originated the Jet process. It's the *production* record, not the price list, that tells the *true* story of your perforating costs.

Call the nearest Welex Station collect for prompt service day or night. Write for Bulletin.

Welex® *THE ORIGINAL JET PROCESS*

JET SERVICES INC.

General Office: 3909 Hemphill Street, Phone 4-3245, Fort Worth, 9, Texas.
Field Stations: Falfurrias, Houston, Odessa, Snyder, Victoria, Wichita Falls, Tex.; Ardmore, Lindsay, Shawnee, Okla.; Shreveport, La.



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JOURNALLY Speaking

Older Brother

THE refining industry is exactly 100 years old this year. That makes it 9 years older than the petroleum industry.

How come? The first oil refinery went on stream in Scotland in 1850. Its feed stock was coal, and its product was "coal oil." Coal oil immediately became popular for lighting homes, and promised to supplant scarce whale oil.

Within a few years there were coal-oil refineries in the United States, doing a brisk business. Then one day a chemist told Colonel Drake that the goo he had skimmed off Oil Creek in Pennsylvania could be refined into coal oil, and so the petroleum industry came into being.

Thus there is no question in the oil industry as to which came first, the hen or the egg. And for nearly a century the refining branch has controlled—or led—the producing branch. For while production and refining must fit together like a hand in a glove, it is, by and large, what the refiners can make and sell that determines how much crude oil will be produced, what kind of crude, and, pretty much, where.

That's why production and refining are not separate industries but parts of one big industry. That's why production men need to keep tabs on trends in refining, and vice versa. And that's why our favorite oil publication has quite a bit on both—along with all other branches of the industry—every week.

Only this week there is special emphasis on refining, and in a big way. It's an annual custom, and proof that it's a good one lies in the number of outstanding refining authorities who wrote special articles for this issue so that other refiners can share the benefits of their experiences.

Century of Progress

REFINING has come a long way since the coal oil of a century ago. For instance, the early-day refiner knew nothing about propylene polymerization. What's that? You don't understand propylene polymerization, either? Well, then, turn to page 252 right away and read all about it.

But first, perhaps, you will want to brush up on your general refining knowledge by studying the 40-page section of process diagrams and descriptions starting on page 171. Here are thumb-nail summaries of the most common and important processes used and discussed today. If you're a production man you ought to know something about what the refiner has to do to your crude to make into something people will pay money for, and if you're a refiner this section will be a handy reference and memory-jogger. In fact, we figured it would be so popular that we are having it reprinted as a pamphlet which our Reader Service Department will mail on receipt of one buck.

But these blueprints don't begin to show the complexities of modern refining. Refining's century of progress has made it into one of the most intricate and finely balanced combinations of technology and economics to be found in the world.

And the end is not yet. Starting its second century, refining is plugging ahead with experiments on new processes and new products which in a few years might put much of today's operations in the same class as the 1850 coal-oil plant.

Demonstration of this can be seen in the advertisements in this issue, which are just as much a part of it as the special articles.

Progress comes fast in refining, and this publication is keeping right up with it every week. For proof, look at next week's issue. It will carry the first published description of a brand-new refining process, a process so new it couldn't be included in our 40-page blueprint section this week but one which already has aroused great interest in the industry.

Looks like the next century will record a lot of progress, too.

—*Henry D. Ralph*

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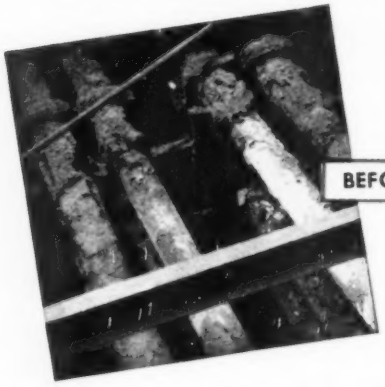

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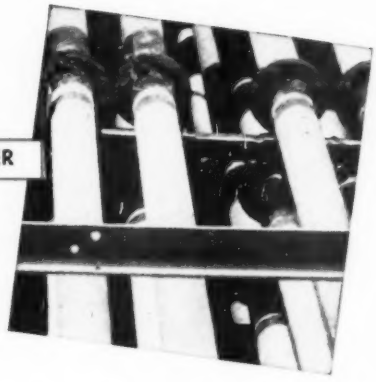

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The OIL AND GAS JOURNAL

VOL. 48, NO. 46 MARCH 23, 1950

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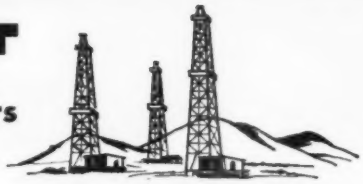
A RIG SIDE CHAT

about Baker Retainer Production Packers



What we want to talk about today is how the Baker Production Packer is set securely in the casing, anchored against either upward or downward movement, with the tubing production string left free from the packer. The tubing is run through the body of the packer for production, and is free to be pulled at any time without disturbing the packer. In the typical application drawing (far right) the packer has been set and anchored to the casing by the two sets of opposing slips, with the Hycar packing unit sealed-off against the casing and retained in position by lead seals.

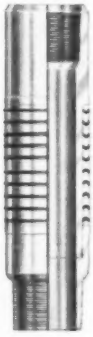
We want to produce from a zone below the packer so we make up the string with a Baker Perforated Production Tube on bottom (with operator's tubing to provide an additional stinger, if desired); above is a Baker Multi-V Tubing Seal Nipple; next a No Left Turn Latching Sub; and above that comes the tubing. Now we run-in the well until the Latching Sub engages in the top of the packer. The engaged Sub automatically positions the Multi-V Tubing Seal Nipple accurately in the smooth bore of the packer, and with 5 Hycar rings facing up and 5 more facing down, a perfect seal is obtained between the tubing string and the packer bore. Meanwhile, the Perforated Production Tube, as it was run through the bore of the packer, has unseated the Flapper Valve and now holds it in open position.

It's as simple as that, and we are ready to produce through the $\frac{3}{8}$-inch holes in the Perforated Production Tube. These holes prevent junk, debris and large pieces of shale from entering and clogging the production string; and the total area of all holes is equal to or greater than the area of the tubing string.

When the tubing string is pulled at some future time, the Flapper Valve in the lower end of the packer body snaps back into the closed position and maintains a fluid-tight seal against upward pressure from below. The packer is not disturbed by pulling the tubing string, but remains packed-off against the casing ready for future operations.

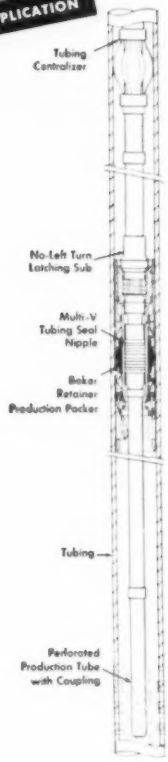
This is only one of the many applications of the Baker Retainer Production Packer for single-zone or multiple-zone production; for selective testing and acidizing; for protection of casing from pressure or from destructive fluids, or gases; and other profitable uses.

Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

TYPICAL APPLICATION



Single zone hook-up with production string anchored to packer, for: (a) keeping production string in tension to eliminate "tubing breathing" during the pumping cycle; (b) producing by flowing, without imposing excessive weight on packer to hold Tubing Seal Nipple positioned in packer bore; (c) making high pressure injection of gas or fluid for re-pressuring or secondary recovery.

Production string is run-in until No Left Turn Latching Sub rests on top of packer, indicated by drop in weight on strain gauge or weight indicator. The production string is then raised about 5 feet, and the zone washed and brought in, if it will flow.

If you would like to continue this rig-side chat at any well where you have a production packer problem, call the nearest Baker "Service Engineer." He will have helpful suggestions, and he is as near as your telephone . . .

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PRODUCT NO. 415-D

Normalcy in Refining

Here are a few figures concerned with petroleum refining in this country as of today.

There are 346 active plants with a total rated crude-oil capacity of 6,540,265 bbl. daily. Compared to a year ago there has been a decrease of 34 in operating plants but a small increase in capacity to refine crude oil.

Of greater significance is the fact that the capacity of the cracking operations has jumped from 3,752,390 to 3,976,300 bbl. daily during the past year. Other facilities which add to plant efficiency have also been expanded.

With an average weekly wage of $75.10 the domestic refining industry maintains its top position among major industries in compensation to employes. The weekly wage is 38 per cent higher than the national average for all industries, according to the latest report of the Department of Labor, and the hourly rate is 36 per cent greater.

No statistical data adequately reflect the scope of refinery operations. Most industries consider themselves fortunate if their plants average an 8-hour day, 5 days weekly. Refineries operate around the clock throughout the year. Most of the plants listed in the Journal's annual survey in this issue have had one or more distillation units and all plant utilities in continuous operation for periods ranging from 25 to more than 50 years.

So much for the present and past in refinery operations. What of the future? Refinery operators and those who serve them like to know that domestic operations have more than doubled since the boom year of 1929, but they are more concerned with what will happen to their business this year and 5 years from now.

The phenomenal postwar growth brought about by the restrictions on construction during the war, and record peacetime demands, have leveled off. Some who are not familiar with petroleum refining have assumed that construction needs are now taken care of for a prolonged period.

Petroleum refining is never static. Normalcy in refining means consistent progress. Following the temporary contractions in total operations last year, the normal growth will get under way again this year.

Having caught up with bulk demands, refiners will now have time to give more attention to those matters having to do with plant efficiency. These and allied activities are now supported by one of the largest if not the largest research and development program of any industry.

One company which is spending 18 million dollars this year on its refinery research explained its operations simply as "the main objectives of the program are to develop new petroleum products and processes and to improve existing ones."

With this background duplicated throughout the industry, it is certain that petroleum refining is now moving into a period whose accomplishments will dwarf those of the past.

THIS WEEK

PRORATION—Texas increases allowables for April, but its proration system is under heavy fire. . . . Having junked the MER method, it finds the substitute brings many new problems. . . . Heavily cut areas charge discrimination, and some refiners can't get the right types of crude. . . . Reduced income from crude production is making a serious dent in the state's economy. . . . 'Other oil states, particularly Louisiana and Oklahoma, are examining their own proration methods in the light of Texas' experience. . . .

FUELS COMPETITION—Demand of Independent Refiners Association that production of natural gas and natural-gas liquids be prorated like crude oil points up growing impact of this competition. . . . Brief to Texas commission declares that crude and its products suffer from lack of equitable restrictions on the light hydrocarbons. . . . 'Stanolind official charges Interior Department with false cost estimates and misleading propaganda in effort to promote synthetic-fuels program. . . . 'Bill in Congress to study coal's economic problems proposes national fuel policy embracing oil and gas. . . .

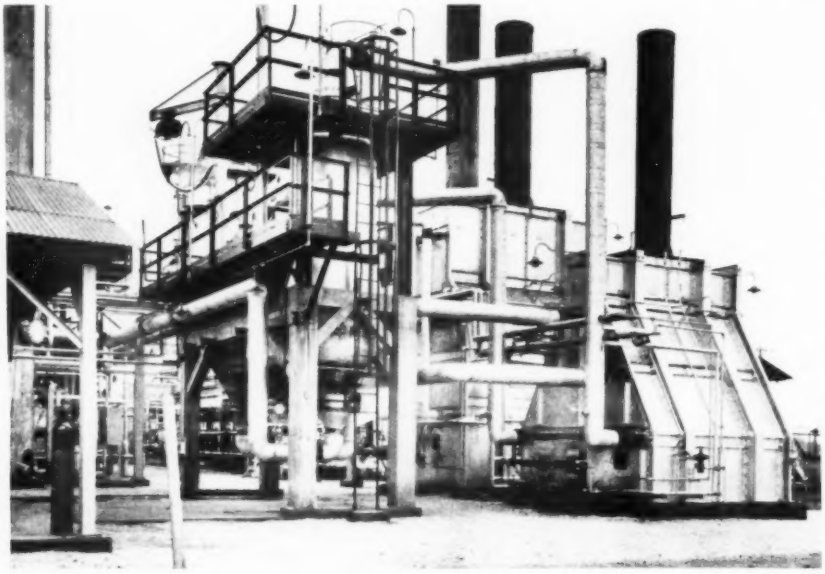
FOREIGN TRADE—New attempt begun in Congress to limit petroleum imports to 5 per cent of domestic demand. . . . Administration opposed, but similar try last year missed Senate approval by one vote. . . . 'State Department preparing strong note on British ban on dollar oil. . . . Designed to force Britain to change policy or admit discrimination. . . . 'Administration beats down Senate move to keep Marshall-plan countries from discriminating against U. S. oil and other industries. . . .

TRENDS—Stocks of gasoline, kerosine, and distillate fuels east of California were 24,890,000 bbl. less on March 11 than at the peak on November 5. . . . Gasoline inventories increased 26,880,000 bbl. . . . Kerosine and distillate inventories decreased 54,662,000 bbl. . . . More clean storage is available now than at the beginning of winter. . . . 'In the same period, residual stocks dropped 9,557,000 bbl. despite heavy imports and shipments from California, estimated at 10,000,000 bbl. . . .

ACTIVITY—Daily average crude-oil production for the week ended March 18 was 4,776,550 bbl., an increase of 14,825 bbl. over the previous week. . . . 'Total well completions increased to 754 compared with 694 for the previous week and 639 in the same week last year. . . . 'Wildcat completions were up 6 wells to 145. . . . Rotary rigs operating in United States on March 13 increased 5 rigs to 1,967. . . .

INTERNATIONAL—World crude production outside U. S. went up nearly 1 per cent in January to 4,600,800 bbl. daily. . . . Venezuela and Qatar chiefly responsible for increase. . . . But big drop in U. S. output brought total world production down slightly. . . . 'Venezuela begins program of heavy cuts in crude production. . . . February output at lowest point since summer, a drop of 145,718 bbl. daily below January. . . . 'Pemex begins construction of pipe line across Isthmus of Tehuantepec.

NATURAL GAS—Kerr bill to exempt independent gas producers from FPC control meeting strong Senate opposition. . . . Consumer states claim it would cause big increase in prices. . . . Sponsor denies this and claims President Truman will sign. . . . 'FPC case against Phillips Petroleum Co., key to policy on jurisdiction over producers, postponed to May 1 at company's request. . . . 'Texas Eastern Transmission Corp. will get 250,000,000 cu. ft. of gas daily from Algonquin Gas Transmission Co. for resale to New England utilities. . . .



WRAPS OFF.—Details of the Platforming process, which has aroused much interest among refiners, will be revealed at the Western Petroleum Refiners Association meeting next week and reported in the next issue of the Journal. This is the heart of the only commercial unit in operation, at Old Dutch Refining Co., Muskegon, Mich. In the reactors, left, straightrun naphtha and gasoline are catalytically reformed to higher octane products at yields substantially higher than with thermal reforming. Two of the furnaces are at the right.

Proration Protest

Railroad Commission hears widespread criticism of new method of fixing allowable; Humble voices chief complaint

Roy F. Carlson

FORT WORTH.—A storm of protest over the change in proration formula hit the Texas Railroad Commission at its allowables hearing here March 16.

Representatives of colleges, banks, hospitals, oil operators, labor, and just plain citizens rose at the meeting and told a story of hardship being suffered under the "1947 yardstick" now determining Texas' allowable oil production only on a basis of acreage and depth.

The spokesmen came generally from three areas where production has been cut sharply by the formula change: fields of high potential in East Texas and the Gulf Coast area, the extremely deep producing area in the Permian basin, and the new flush fields in Scurry County.

The effect of the testimony is uncertain. At intervals throughout the hearing the commission members stated that the existing method of proration is nothing new, that it represents a return to a method that was in effect before the periods of extremely high demand. The commission showed that fields which were cut sharply have merely been returned to a previously used rate.

Humble's complaint.—The most elaborate presentation was made by Humble Oil & Refining Co. The Humble people, including an attorney, a crude-oil buyer, and a refinery engineer, showed that a loss of Texas market could occur if the present proration law is kept in force in the Gulf Coast area where the company produces and refines or sells a crude from which a special low-pour-point lubricating oil is made. The crude from which this lube oil can be effectively manufactured is produced from only 36 fields, and primarily from 14 of these.

Humble's Baytown refinery needs, to satisfy markets for the low-cold-test lubes, 53,500 bbl. per day, of which 33,500 bbl. would go to the refinery, the remainder being sold to crude-oil customers. Under the existing proration plan, Humble receives only 22,000 bbl., less than that company's own needs. The only other comparable available crudes are to be found in Venezuela or Colombia, and buyers may have to purchase those crudes to meet demand.

The present yardstick proration method, Humble spokesmen said, has cut several of these fields, which have high producing potentials, inequitably compared to other low-potential fields. The spokesmen said that some of these fields have had their production cut over 50 per cent by the order while the state-wide reduction was only 5 per cent. Further, the Humble attorney cited instances where the ratio of present allowable to MER—most efficient rate—was in the neighborhood of 20 per cent, as compared with a ratio of 82.5 per cent for fields like East Texas.

Humble suggested a return to the MER system of basing allowables, with all fields in the state being granted an equal number of producing days. Until March, East Texas field was allowed two fewer days of production than were the rest of the prorated fields.

Depth formula.—Operators engaged in drilling the deep Ellenburger wells in Midland and Upton counties also lodged a protest against the yardstick formula, saying it took away the incentive to develop the extremely deep pays. Representatives of these West Texas operators said that drilling costs for the deep wells increase far out of proportion to increased return from production under the allowable method now used.

The tremendous hazard in drilling these 13,500-ft. wells which require much longer trip time, a large mud volume, high mud-treating costs, and the use of very expensive equipment jumps the cost of these wells to over $350,000 as compared to a cost of $175,000 for a well 10,000 ft. deep.

General American Oil Co., one of the companies engaged in this deep drilling, suggested the yardstick allowables given in the accompanying table.

SUGGESTED FORMULA

Depth, ft.	Allowable bbl. per day
10,000-10,500	200
10,500-11,000	225
11,000-11,500	255
11,500-12,000	290
12,000-12,500	330
12,500-13,000	375
13,000-13,500	425
13,500-14,000	480

General American also suggested that the allowables for deep discoveries follow this plan, but be exempt from shutdown days. Other operators in the field generally concurred with the plan suggested by General American.

Depleted incomes.—Delegations from Thompson and Van fields also violently protested the effect of the change in proration methods. These two fields, along with many others, were cut sharply when the yardstick order went into effect on March 1.

The representative of Van field interests said that residents of the town of Van were faced with increased taxes, and because of suddenly reduced incomes were forced to discard expansion plans. Comparing the cut in Van's production of 50 per cent with a cut in state-wide production of 5 per cent, and speaking of the apparent injustice of such a cut, the spokesman said: "I know nothing of MER, or the 1947 yardstick, but am thoroughly conversant with a depleted pocketbook."

A similar attack was made by people affected by a sharp reduction of allowable in Thompson field. In illustration, representatives said the University of Houston is, through bequests, an owner of royalty in the field and has established building plans on income from the royalty. Decreased income will force up the cost of tuition, causing many students to leave the school. These people also complained of the apparent injustice of the allowable cut in Thompson field compared to the state-wide total, saying it was like robbing Peter to pay Paul, with Peter being badly hurt.

Operators in Scurry County flush fields also claimed to be discriminated against, and asked for return to the MER method of fixing allowables.

The question of imports was also injected into the commission hearing by R. L. Foree, the recently elected head of the Texas Independent Producers and Royalty Owners Association, and by Superior Oil Co. Large imports of foreign crude oil was blamed by them for reducing the market for Texas crude.

The question of prorating the production of natural-gas liquids was also raised, but was not discussed fully at this meeting, since it is to be the subject of a special hearing of the commission.

Humble Buys Kent Spread

DALLAS.—Humble Oil & Refining Co. bought into the central Kent County Canyon reef play last week with a checkerboard spread of leases in 17 sections, all in Block G, Waco & Northwestern Railroad Survey.

The leases total 1,360 acres out of the A. A. Atkins Estate ranch, for a cash consideration of $1,360,000. Purchase was made from Lucerne Corp., Dallas, and others.

In the deal, Humble acquired the east half of the northeast quarter of

the following sections: 114 and 115; 101, 102, 103; 84, 85, 86; 72, 73, 74; 53, 54, 55; and 42, 43, and 44.

The southern part of the ranch, Sections 42, 43, and 44, are 10 miles north of Cogdell Ranch reef field.

The northern section of the purchase is 4 miles east of Lewis T. Lohman 1 J. W. Young, 98-G-W&NW, which has made a successful producer from the Strawn lime at 7,353-59 ft., after missing the reef.

Three miles to the north lies Caroline Hunt Trust's 1 J. W. Young, which has attracted considerable attention with a tentative Canyon-reef top minus datum point 4,116 ft. It was drilling ahead at 6,880 ft. at last report.

Two miles west of the central part of the block, Ted Weiner and Sohio Petroleum Co. 1 Corriker, 87-G-W&NW, had top of the reef at 6,728 ft., or minus 4,476 ft. It drilled soft at 6,725-27 ft. and a drill-stem test was under way this week.

Gas Proration?

I.R.A.A. asks Railroad Commission to allocate production of gas, gas liquids on market-demand basis like crude oil

FORT WORTH.—A request that the production of natural gas and natural-gas liquids be controlled by the same rules that apply to crude oil was made to the Texas Railroad Commission at its proration hearing here March 16 by the Independent Refiners Association of America.

The subject was taken under study by the commission, and a special hearing probably will be held.

The advantage which gas hydrocarbons have under the present proration method is an important factor in the present "petroleum depression" in Texas, the I.R.A.A. declared.

The association specifically requested:

1. Proration of gas production based on market demand for gas and its products.

2. Ratable take from gas wells in place of selective buying which permits some wells to produce heavily while others are shut in.

These steps, it said, would put gas hydrocarbons and oil hydrocarbons on an equal basis in a competitive market, whereas existing laws have the effect of giving an advantage to one segment of the petroleum industry and restricting the other.

Petroleum depression.—The petroleum industry in Texas is suffering a depression in the face of an all-time high in demand for petroleum products in the United States, the I.R.A.A. brief declared, and cited these statistics:

During the week ended March 4, refineries in inland Texas ran crude oil at 77.3 per cent of capacity and Texas Gulf Coast refineries ran at 76.2 per cent of capacity. More than 23 independent refineries are shut down out of a total of 89 refineries in the state. The 23 per cent of capacity which is idle could handle an additional 600,000 bbl. of crude daily, or approximately all the present shut-in production of Texas.

Refining of crude oil during 1949 was 8 per cent below that of 1948, whereas during the same period the production of light gas hydrocarbons increased more than 7 per cent. Natural-gasoline production represents 8 per cent of the total hydrocarbon production and is increasing each year. On a B.t.u. basis approximately 6,000 cu. ft. of gas is equivalent to 1 bbl. of crude oil.

Action requested.—In requesting the commission to set up a proration method having the same set of rules for each of the hydrocarbons, the I.R.A.A. said:

"Crude oil today is prorated by various rules and regulations. We find that acreage spacing allows an advantage to gas and a disadvantage to crude oil in producing equal quantities of equivalent energy units.

"Gas production is prorated to only 25 per cent of potential ability to produce, whereas crude-oil allowables are set as a result of nominations or market demand, reservoir conservation, gas-oil ratio, water percentages, potentials, acreage, bottom-hole pressure, and other factors.

"The gas purchaser operates cycling plants at the capacity of the plant regardless of market demand as there are no restrictions on the amount a cycling plant can process from gas. Therefore, an unlimited volume of gasoline hydrocarbons are produced by this method regardless of market or nominations from purchasing companies.

"The transmission lines furnishing ever-increasing amounts of hydrocarbons competing with crude oil have no restrictions other than the volume they are able to sell on the open market through the United States. While crude oil is held down to market demand and ratable taking within fields and between fields, these lighter hydrocarbons displace crude-oil refinery products because of their unrestricted operations.

"The gas companies can purchase producing properties and make these properties their sources of supply of gas hydrocarbons. Crude-oil purchasers cannot buy their production and make that point their source of supply because the laws of Texas require that they must take ratably from all producing crude-oil fields in the state. Therefore, we do not have crude-oil wells shut in but we do have gas wells shut in."

Higher Allowables

Texas fields cut in March given higher April figure

AUSTIN.—The Texas Railroad Commission this week fixed the state's April allowable at 2,088,722 bbl. daily, an increase of 130,376 bbl. daily from the March figure.

The commission spread the increase over the 134 fields in which allowables were cut sharply for March. Production will be on the 17-day pattern established for March.

In announcing the figure, the commission said the increased allowable figure will, in effect, restore about 45 per cent of the cut in production ordered for the 134 fields.

The increase followed a storm of protests from producers at last week's allowable hearing in Fort Worth. Most of the protest originated in the areas most seriously affected by the March order, and it is these areas which will benefit by the April increase.

At the Fort Worth hearing the commission appeared reluctant to authorize much of an increase in spite of the fact that major purchasers increased their nominations by 86,281 bbl. daily over March.

Stock levels were termed by the commission to be a better indicator of market demand. They also noted the forecast of the U. S. Bureau of Mines that the demand for Texas crude would be some 40,000 bbl. daily below the March figure of 2,060,000 bbl. daily.

The commission expressed the view that in the face of gasoline stocks much higher than desirable and with crude-oil storage figures also very high, they were "anxious to be shown" that there is a basis for an increase in crude-oil allowables.

The "desirable" level for gasoline stocks has been set at 120,000,000 bbl. on April 1, the start of the consuming season. These stocks now, according to the American Petroleum Institute, are in excess of 135,000,000 bbl. Company spokesmen argued that these excess stocks would not be undesirable since consumption or demand for motor fuels is up 3.9 per cent throughout the country.

The crude nominations for April totaled 2,356,102 bbl. daily, as compared with 2,269,871 bbl. daily for March. Most of the increase was called for in West Texas and the Gulf Coast, where respective in-

creases of 49,476 and 20,337 bbl. were asked. These two areas were the most deeply affected by the switch to the yardstick method of proration.

With the increased crude nominations, purchasers generally recommended an increase in the number of allowed producing days. Most of the purchasers' representatives suggested not less than 18 days, compared with the 17-day interval for March, with some saying they would take 19-day production.

New Reef Field

Borden County wildcat of Barnsdall flows gas, oil

A NEW Canyon reef field apparently has been opened by Barnsdall Oil Co. in south central Borden County.

The well is the Barnsdall 1 Wilson, NE NE Section 16, Block 27, H&TC Survey, along south line of the county. It topped the Pennsylvanian Canyon reef at 7,410 ft., or datum of —4,925 ft., and after drilling in 10 ft., took a drill-stem test on March 21. The well has flowed gas and oil into the slush pit preparatory to gaging.

This is the third new field in southeastern Borden County, as Amerada Petroleum Corp. and George Livermore each found new pools in the area recently. The Barnsdall well is 9½ miles west of the Livermore discovery and 10 miles east of Vealmoor field which produces from the Canyon reef and has a water level of around —5,325 ft. It is on a block of 6,500 acres recently acquired from Pacific Western Oil Co. on a farmout.

These new Borden County fields may prove to be continuations of the big Canyon and Strawn reef structures now outlined northeast-southwest completely across Scurry County, which adjoins Borden on the east.

The general water level in the Scurry area is about —4,500 ft. The nearest test to the east of the Barnsdall strike was a dry hole, Standard Oil Co. of California 1 Griffin, about 2½ miles east of the Wilson, in NW NW of Section 35. The Griffin dry hole had water in the reef at —4,785 ft.

Since the new prospect is regionally down dip from the Scurry County area and up dip from the Vealmoor, geologists speculate that it would be reasonable for the water level to be somewhere in between the —4,500 ft. in Scurry County and the —5,300 ft. in Vealmoor. The fact that it looks like an oil producer in the reef, nearly 140 ft. lower than the Standard's Griffin test, which was dry, makes it appear to be a separate oil accumulation.

WEST COAST

Elk Hills Plans

Number of rigs is cut from 7 to 5, building of facilities deferred; Greenman tells Congress field will break even

WASHINGTON.—Plans for development of Naval Petroleum Reserve No. 1 (Elk Hills) have been cut back by $5,431,000 for the fiscal year which begins next July 1, and the number of drilling rigs has been reduced from seven to five, it was disclosed last week by the House appropriations committee.

The committee made public testimony of Com. William G. Greenman, director of naval petroleum reserves, reporting that government operations in the reserve will pay their own way from the Navy's share of the oil produced under the unit contract with Standard Oil Co. of California.

Expenditure of only $3,419,000 now is planned for development of Elk Hills field, which will include some $750,000 for another well into the Lower Miocene, where some time ago an 11,400-ft. hole indicated reserves of considerable importance. The well, however, was on the flank of the pool and was not completed for commercial production.

Program adequate.—Greenman told the committee that the reduced drilling program, which also includes deferment of the construction of facilities, will be adequate to permit a real evaluation of the reserve. The department will drill up about one-third of all the locations, with a view to getting productive capacity that can be sustained over a period of years.

Original plans for development call for the drilling of some 350 wells over a period of 10 to 12 years at an expenditure of some $80,000,000, Greenman said, but more recent studies indicate that as many as 867 may be necessary ultimately. The estimated recoverable reserves are 700,000,000 bbl., and a maximum rate of production of 215,000 bbl. daily is expected when development is completed.

"On the basis of five strings of tools for developing the field, continuing with that number of rigs over the next 5 years, we believe that we will have the field developed to the point where we will have available to us production which we can sustain in time of emergency by drilling up the remaining locations," Greenman said. "We are just going far enough to give us the initial sustained production, and then when the emergency comes we will ask for the extra money to drill up those inside locations to take care of the decline in production."

To break even.—Greenman drew commendatory comments from the committee when he reported that in the long run the Government will break even on the project. By next July, he explained, about $34,000,000 will have been spent for exploration, development, and maintenance, and over the next 5 years expenditures will run about $6,000,000 a year. Income up to next July is estimated at $16,000,000.

The estimated long-run income will be in the vicinity of $4,250,000 a year, he said, "sufficient to enable the Government to pay some $500,000 a year for readiness costs, maintenance, and operation of the field; amortize the total investment in 20 years; pay 2½ per cent interest on the unamortized balance each year; and make a net income."

Greenman also reported that the geophysical reconnaissance of Naval Reserve No. 3 (Teapot Dome) has been completed, and while no funds are requested for the coming fiscal year it is expected that money will be asked for in 1952 to drill one or two wells to determine whether the structure contains oil in commercial quantities.

It is not believed any important volume of oil will be developed and there is no thought of developing the field as Elk Hills has been developed, but the Navy wants to know how much oil it might count on in the event of an emergency.

ASSOCIATIONS

W.P.R.A. to Meet Next Week

SAN ANTONIO.—An estimated 1,000 refiners are expected to attend the thirty-eighth annual meeting of the Western Petroleum Refiners Association, to be held here March 27-29.

Three technical sessions and one general session have been scheduled for the 3-day meeting.

Principal addresses at the general session will be presented by R. W. McDowell, Mid-Continent Petroleum Corp., Tulsa, president of W.P.R.A.; John L. McCaffrey, president of International Harvester Co., Chicago; and Walter S. Hallanan, president of Plymouth Oil Co., Pittsburgh.

Technical papers on the 3-day program include:

"Fuel Oil Markets—Past and Future," Albert J. McIntosh, Socony-Vacuum Oil

Co., New York; "Four Gas Turbine Plants," Bruce O. Buckland, General Electric Co., Schenectady; "Platforming," Dr. Vladimir Haensel, Universal Oil Products Co., Chicago; "Modern Trends in Industrial Water Treating," Dr. R. C. Ulmer, E. F. Drew & Co., New York; "Trends in the Utilization of Motor Fuels in Automotive Transportation," John M. Campbell, General Motors Corp., Detroit; and "Progress and Trends in Petroleum Refinery Instrumentation," Douglas M. Considine, Minneapolis-Honeywell Regulator Co., Philadelphia.

S. G. A. Convention

With a slogan of "Forward in Fifty," the Southern Gas Association will open its forty-second annual convention in Galveston on March 27. Continuing through March 29, members will hear discussions on marketing of flare gas, remote-controlled gas-distribution systems, and safety measures.

The meeting will be divided into several sections, including accounting, employe relations, operating, and sales.

Among papers to be presented in the operating section on March 27 are the following:

Round-table discussion on accident prevention, led by R. D. Price, chairman, Louisiana Power & Light Co.; "Natural-Gas Odorants," by Dr. Frank H. Dotterweich, Texas A. & I. College; "Remote-Controlled Gas-Distribution Systems," a panel discussion led by L. A. Bickel, Lone Star Gas Co.; "Effects of Oil Proration on Marketing of Flare Gas," by Paul Kaywer, El Paso Gas Co.; and "Effect of Gas Proration on Gas-Transmission Operations."

On March 28, G. C. Rawls, Louisiana Power & Light Co. will speak on "The Operating Man's Job in Employe Relations," and on March 28 the following will be given: "Transmission Problems," panel discussion; "Application of Radio Communications in Gas-Distribution Operations," by T. J. McMullin, Communications Engineering Co.; and "Mechanization—A Challenge to Rising Costs," panel discussion led by J. H. Collins, Sr., New Orleans Public Service, Inc.

Mid-Continent A.P.I.

Various papers on subjects pertinent to the producing phase of the petroleum industry will be presented at the spring meeting of the Mid-Continent District, American Petroleum Institute's Division of Production, which will be held at the Skirvin Hotel in Oklahoma City March 29-31.

Wallace Hawkins, Dallas, vice president and general counsel of Magnolia Petroleum Co., will be the principal speaker at the opening session.

Among papers to be presented will be:

"Drilling by the Turbine Method," by Critchell Parsons, Engineering Development Co., Dallas; "Applications of Emulsion Drilling Fluids in California," by Thad Randolph and Doyne L. Wilson, Oil Base, Inc., Compton, Calif.; "Relative Economics of Diamond Coring to Conventional Coring and Drilling," by C. Deely, Drilling & Service, Inc., Dallas; "A Study of the Buckling of Rotary-Design Strings," by Arthur Lubinski, Barnsdall Research Corp., Tulsa.

"A Preliminary Report on Oil Recovery by High-Pressure Gas Injection," by L. P. Whorton and W. L. Kieschnick, Dallas; "A Review of Gun-Perforating Methods," by Val Forsyth, Lane-Wells Co., Los Angeles; "Use of Plastics in Producing Operations," by Tom Hamilton, National Cooperative Refinery Association, Wichita; "Some Examples of In-Fill Drilling," by H. H. Kaveler, Phillips Petroleum Co., Bartlesville, Okla.; "Vocational Training in Oil-Well Drilling and Production Operations," by John Woodruff, University of Texas, Austin.

Houston A.C.S. Meeting

HOUSTON.—Three important symposia will feature activities of the Division of Petroleum Chemistry at the March 26-30 meeting here of the American Chemical Society.

Subjects will be chemicals from petroleum, synthetic lubricating oils, and conditioning water for repressuring oil fields and for underground disposal.

All will be held on March 26. Headquarters for the A.C.S. meeting will be in the Shamrock Hotel.

In addition to the symposia, many individual papers of particular interest to the petroleum industry will be presented during the general sessions.

Dr. Kenneth S. Pitzer, director of research, United States Atomic Energy Commission, will be awarded the $1,000 Precision Scientific Co. award in petroleum chemistry. Dr. Herman A. Ries, Jr., Sinclair Refining Co., Harvey, Ill., is to receive the $3,000 Ipatieff prize in chemistry and Prof. I. M. Kelthoff, University of Minnesota, will be given the $1,000 Fisher award in anayltical chemistry.

North Texas Meeting

WICHITA FALLS.—Seven technical papers will be presented at the twentieth annual meeting here March 25 of the North Texas Oil and Gas Association.

Speakers at the annual dinner will include J. Ed Warren, president of Independent Petroleum Association of America, Midland, and Bruce K. Brown, president of Pan-Am Southern Corp., New Orleans.

Technical papers will include:

"Water-Flood Survey, North Texas," Rollie P. Dobyns, U. S. Bureau of Mines, and Verdun Leonard, Magnolia Petroleum Co.; "Some Aspects of Core Analysis as They Apply to Secondary Recovery," Ray Staples, Cable & Stine; "Secondary Recovery and Stripper Well Reserves of the United States," A. E. Sweeney, Jr., Interstate Oil Compact Commission; "Reservoir Engineering in Secondary Recovery," Donald T. May, Ryder Scott Co.; "Importance of Water Selection and Treatment in Salt Water Disposal or Water Flooding," R. C. Earlougher, Earlougher Engineering Co.; "Electrodril Coring and Its Application to Secondary Recovery," Sergei Arutunoff, Electrodril Corp.; and "A Year of Hydrafrac in North Texas," W. E. Hassebroek and Tom E. Morton, Halliburton Oil Well Cementing Co.

West Coast Forecast

BAKERSFIELD, Calif.—Gasoline demand, which has doubled in this area in the past 10 years, will continue to increase 3 to 4 per cent a year, Robert L. Minckler, president of General Petroleum Corp., predicted here last week.

Addressing the San Joaquin Valley Oil Producers Association, Minckler also predicted a 4 to 5 per cent yearly increase in stove and diesel-oil demand unless or until a natural-gas line is laid into the Pacific Northwest from Alberta.

He made no forecast on fuel oil because, he said, "this is the product we are going to have trouble with in the future."

"The future of heavy oil," he said, "lies not in its use as a burning fuel, but as a raw material from which gasoline and distillates will be produced. It is a refining, not a marketing, problem."

He added, however, that large refinery investments will have to be made in cracking and coking equipment and that while some progress is being made "there is no pressure to get the job done quickly" as there is plenty of light crude oil available.

NEXT WEEK

New Look Process?—One research engineer has so described the recently developed Platforming process, because of its results in building high octane rating into low-octane straightrun and natural gasolines, with extremely high product yields. This will be the first detailed article on this process, treating chemical reactions, operating variables, properties of finished "platformate"—and the commercial results and operation of first installation at Old Dutch Refining Co., Muskegon, Mich.

Faster Rotary Drilling?—Engineers W. J. Bielstein and G. E. Cannon, Humble Oil & Refining Co., give field results of new jet-type rock bits, point out effects of increasing circulation rate, rotary speed, and bit weight.

Freezing Up Wild Wells?—Use of dry ice sometimes is a fast and expedient method in calming wild wells; J. A. Miller, general superintendent for Otis Pressure Control, Inc., describes a number of actual field cases.

Cutting Down Gas-Oil Ratios?—Shell Oil Co. engineers, T. B. Lambert and R. M. Hippard, give results and costs for 503 workover operations in West Texas and New Mexico fields.

Trends in Treating?—Discussion of this important petroleum refining subject, by Dr. Charles W. Rippie, technical director, American Developments Corp.

Pipe Liners' Big Year

Big projects getting history's earliest start; increased mill capacity points to 1950 as record construction year

Paul Reed

THIS looks like the biggest pipe-line year in history and big projects are starting earlier in the spring than ever before.

For the past several years the capacity of pipe mills in the United States has virtually put a ceiling on the rate of laying new lines, but now this bottleneck has been broken. New mills already in operation, or soon to be, will provide much additional large-diameter pipe, and pipe-line companies are making the most of this larger supply.

Because of the magnitude of the construction programs already announced for this year, work has started earlier than normally, and many projects will be in full swing during the expected wet spring weather.

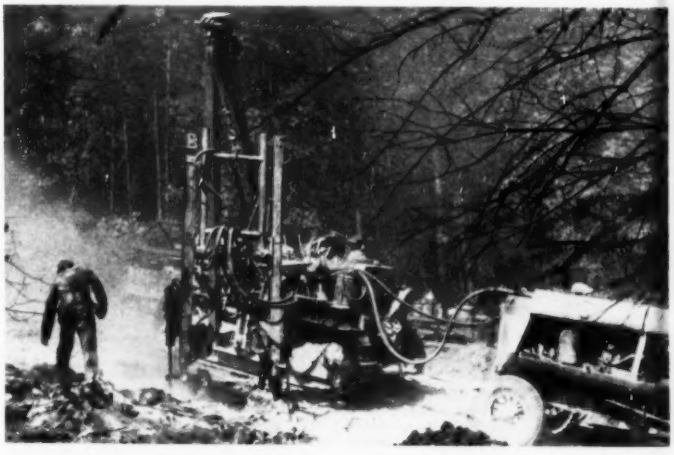
World-wide pipe-line projects under way and planned for the future total approximately 40,000 miles for petroleum and natural gas. Of these nearly 28,000 miles are to be built in the United States, where largest undertakings will be for approximately 23,000 miles of natural-gas lines, which will dominate the pipe-line situation for the next few years.

The continuing growth of gas lines for the next 5 years is indicated by forecasts of interstate movements of natural gas amounting to 5,460,000,000 cu. ft. daily in the 1951-52 period and 9,030,000,000 cu. ft. in the 1955-56 period.

Between these two periods it is predicted that such gas movements will jump 3,570,000,000 cu. ft., or 60 per cent over the 1951-52 movements. In this 5-year period Middle Atlantic movements are to go from 1,150,000,000 to 2,550,000,000 cu. ft.; South Atlantic from 1,600,000,000 to 2,600,000,000 cu. ft. Extensive construction of loops, extensions, and new projects will be needed to meet this demand.

United States crude lines under way and planned amount to more than 3,100 miles and will be increased by the construction of additional big-inch lines to replace parallel smaller-diameter lines in accord with the postwar trend toward achieving economies possible with big-inch opera-

Lowering in 30-in. pipe for Transcontinental Gas Pipe Line Corp.'s Texas-New York system. This section is contracted by Midwestern Constructors, Inc.



Drilling shot holes along route of East Tennessee Natural Gas Co.'s 22-in. Greenbriar-Oak Ridge, Tenn., line. This section is contracted jointly by Oman Construction Co., R. H. Fulton & Co., and Brodie Construction Co.

Arkansas River crossing at Tulsa for the Great Lakes Pipe Line Co. project involving extensive looping of the company's system with 12-in. The project will cost more than $50,000,000.

tion. There will also be the normal additional laterals and extensions.

The economic advantages of products lines continue to be exploited on a more extensive scale. For this service more than 1,800 miles are under construction and planned.

Because of the great increases in pipe-making capacity, largely due to new pipe mills going into production in 1950, pipe-line building promises to be accelerated to a possible 15,000 to 20,000 miles laid this year.

Line-pipe-production capacity in 1950 appears to represent an increase of approximately 36 per cent over that of previously operating plants. The greatest increase in this new plant capacity is for making electric-weld pipe of both expanded and non-expanded types. Line-pipe production in 1950 is expected to be 45 per cent above that for 1948. Experience has shown that 90 per cent of line pipe production goes to the petroleum industry.

Synthetics "Confusion"

Solliday says Chapman is misleading the public when he says synthetic liquid fuels cost only 9 cents a gallon

THE federal Government is putting out misleading claims regarding the cost of producing synthetic liquid fuels from shale and coal, it was charged this week by A. L. Solliday, executive vice president of Stanolind Oil & Gas Co., Tulsa.

A. L. SOLLIDAY

He challenged cost estimates in the recent annual report of the Secretary of the Interior, Oscar L. Chapman.

According to the U. S. Bureau of Mines, jet, diesel, and residual fuels could be manufactured from oil shale of 9 cents per gallon. Solliday, whose company has conducted much research on synthetic fuels, said that industry estimates place the cost of gasoline from shale at about 22.5 cents per gallon. He charged that the Government is confusing the public by basing cost figures for synthetic fuels on calculations that are sometimes "no more than wishful thinking."

How bureau figured.—Calling the bureau's estimates "misleading to the American people," Solliday said that the industry and Government figures were not comparable. He stated that:

1. The bureau's figures leave out the cost of housing workers at remote mining areas and the cost of transportation of products from the mine to a market area.

2. The bureau has computed its costs on low-premium products such as jet, diesel, and residual fuels which have little market value or demand, whereas industry has based its cost on high-premium motor gasoline.

3. The bureau allows too low a return on capital investment—only 3 per cent—in spite of the great risk involved in such a venture.

4. The bureau puts capital investment at unrealistic low levels.

Solliday also charged that the bureau used investment costs which have been lowered in anticipation of possible future development, saying: "To figure probable costs on the basis of processes which have not yet been discovered is no more than wishful thinking. Our estimates have been worked out on the basis of processes which we know are here today, and not based on what we hope may work in the future."

The secretary's report also contained bureau figures on cost of gasoline from the coal-hydrogenation process. This cost would be 14.5 cents a gallon, as compared to industry estimates of 22.5 cents. As in the case of oil shale, the bureau's figures inadequately show the basis for arriving at their estimate, Solliday said.

To enable the public to judge whether synthetic fuels represent a sound or unsound investment, he said the bureau should publish detailed breakdowns of all its economic calculations including investment costs. "Until the bureau does so, the public will continue to read conflicting reports about the cost of synthetic fuels. The end result will be confusion on this vital subject — confusion which we as a nation cannot afford."

What Chapman said. — The department's report, which drew Solliday's criticisms, contained such statements as these:

"Appraising progress in terms of estimated product cost, a primary factor considered by private industry in making new investments, refined products now could be produced from oil shale and coal at actual costs averaging 7.3 and 10.8 cents a gallon, respectively. If a profit of 6 per cent on the average unamortized capital investment is added, plus income taxes, the wholesale price for products at the plant would average 9 cents a gallon for those from oil shale and 14.5 cents for those from coal.

"The capital investment now required for a plant producing 10,000 bbl. a day of crude shale oil, or 8,840 bbl. daily of refined products, is estimated at $41,381,000, including facilities for mining, retorting, and refining. This is an average of $4,138 for each daily barrel of crude-oil capacity or $4,681 per daily barrel of finished product. This plant would produce jet and diesel fuel primarily, plus a small amount of fuel oil. The removal of sulfur and nitrogen is no longer a serious problem, and motor gasoline may be produced readily by modification of the refining process.

"Production costs for shale-oil products even now are within or very near the competitive range of those from petroleum. Another problem remains, however — a market for the products. The oil-shale area of western Colorado is sparsely populated and could not absorb the entire output of a 10,000-bbl.-a-day plant.

"Construction of a 50,000-bbl.-per-day pipe line could provide transportation to large consuming centers at a total cost of less than 1 cent a gallon, but would require the outputs of five 10,000-bbl.-per-day plants for capacity operations. This means that a large capital outlay of approximately $240,000,000 would be necessary for plants and pipe line at the start of commercial development.

"The estimated capital investment for a modernized coal-hydrogenation plant producing 30,000 bbl. a day is $246,800,000, or approximately $8,227 for each daily barrel of products capacity. High-octane gasoline would be the principal product. Byproducts would include liquefied petroleum gases and phenols, for which there is a growing demand.

"Aviation fuel (100-130 grade), now quoted in the coal regions at 16 to 18 cents a gallon, could be sold at the plant for 16.6 cents a gallon wholesale as compared to the 14.5 cents a gallon that would be required for automotive gasoline from coal. Process improvements now under development in the laboratory are expected to reduce these figures."

Joint Attack

Unions united in pension talks with Socony-Vacuum

WASHINGTON.—Normally competitive labor unions representing workers of Socony-Vacuum Oil Co., Inc., have affiliated for a drive on that company for improved pensions, possibly heralding a new development in labor-management negotiations.

In what was admitted by labor leaders to be an unusual alignment of forces, the CIO, AFL and independent unions have formed the Tri-Party Policy Council, to "coordinate" pension negotiations by the unions with Socony-Vacuum management.

Included in the new alliance are not only employes of the parent company but also of various subsidiaries, including Magnolia Petroleum Co. and General Petroleum

Corp. A specific pension program to be asked of the company was worked out recently at a meeting of representatives of the three groups at Denver, but neither its provisions nor the negotiating methods that were adopted has been made public.

In general, however, it is believed the demands on Socony-Vacuum will be much along the lines laid down by the CIO Oil Workers International Union whose national policy committee also met in Denver last month.

The CIO program calls for a $100 minimum for noncontributory pension plans and $125 for contributory plans, with the employe to have the right to all money contributed by himself and to all contributed by the employer on his behalf after the employe has given a specified number of years of service, and pension rights to be protected by a contract clause against any loss or damage in case of strike or lockout. The committee recommended that the union have a high degree of participation in any plan negotiated, but took no stand for or against either contributory or noncontributory arrangements.

The committee also determined to fight for the return of the 36-hour week prevalent in the industry prior to the last war, when it went on a 48-hour week, but without any loss of pay from the reduction of the present 40-hour week.

The oil workers union already has secured a pension plan along the lines laid down, from Sinclair Oil Corp. The Sinclair plan provides that the employe has a permanent right to his own contributions and, in case of quitting or layoff, a right to 50 per cent of what the company has contributed on his behalf if he has had 10 years of service, this increasing 5 per cent a year to reach 100 per cent after 20 years of service. In addition, pension rights are not affected by strike or lockout.

The three-way alliance established by the unions for negotiation with Socony-Vacuum may set a new pattern for labor's pension drive against industries which are not solidly organized under one union banner, presenting a solid labor front which, union men say, would prevent an employer from playing one union against another.

Oil Exhibit Formally Opened

CHICAGO. — A petroleum exhibit, illustrating all phases of the oil industry and the uses of its products, was opened at the Museum of Science and Industry here March 20 with ceremonies and a banquet sponsored by the Chicago Oil Men's Club.

The permanent exhibit was formally presented to the museum by Rawleigh Warner, chairman of the board of Pure Oil Co. Principal address at the banquet was delivered by Dr. Robert E. Wilson, chairman of the board of Standard Oil Co. (Ind.).

The exhibit, 3 years in the making, covers 8,300 sq. ft. of space, and depicts the principal aspects of the different main functions of the industry: occurrence of oil, methods employed in its discovery, production, refining, and distribution, and many uses of petroleum products.

The display includes a full-size oil-field pumping jack in operation, a diorama of the occurrence and finding of crude oil, scale models of derricks and refineries, maps, animated exhibits, and similar educational material. In addition, there is a 50-seat theater where motion pictures of the oil industry are shown continuously. Last year 1,600,000 people visited the Museum of Science and Industry.

In addressing the 500 oil men at the dinner, Dr. Wilson attacked the "revolution by nibbling," by which he meant the gradual undermining of the free-enterprise economy which was responsible for the growth and progress of the oil industry.

To counteract the belief that things would be better if run by the Government, he urged a program of action, including the development of better public understanding of the present system and assistance to other industries threatened with government control.

Working models of early-day and modern oil-field equipment form part of the oil exhibit at the Chicago Museum of Science and Industry.

TECHNOLOGY

Big Research Outlay

NEW YORK.—Shell Oil Co. and affiliated companies are spending about $1,500,000 a month on research this year, with major attention on new chemicals from petroleum and on fertilizers and agricultural chemicals, according to H. S. M. Burns, president of Shell.

Bulk of the $18,500,000 budgeted will be spent in four principal research centers in the United States. The largest of these, with a staff of 1,100, is operated by Shell Development Co. at Emeryville, Calif., where work is done on research in petroleum science to obtain new and better products.

Agricultural research is centered at the 142-acre farm and experiment station at Modesto, Calif., where experiments are conducted on soil fertilization, pest and weed control, soil fumigation, and the effectiveness of petroleum chemicals as insecticides, fungicides, and spray oils.

Exploration and production research is centered in Houston, Tex. At Wood River, Ill., Shell conducts most of its research work on refining problems and special petroleum products such as aviation fuels and lubricants, jet fuels, asphalts, and hydraulic fluids.

Shell also has a customer-service laboratory for chemical products at Union, N. J.; a fuel-oil and oil-burner laboratory at Sewaren, N. J.; and five product-control laboratories at its refineries. Shell laboratories throughout the world employ more than 3,500 scientists and technicians.

Imports Bill Introduced

Thomas asks flat limit of 5 per cent of domestic demand, tells Senate industry cannot survive unlimited imports

WASHINGTON.—A flat limitation of oil imports to 5 per cent of domestic demand was sought last week by Sen. Elmer Thomas of Oklahoma in a bill which would make the quota system permanent through amendment of the Internal Revenue Code.

In a lengthy statement to the Senate, Thomas warned that the domestic industry cannot survive under the impact of unlimited oil imports, now running at approximately 900,000 bbl. a day, and that the present situation is a threat to our national security.

"The domestic industry is capable of supplying the full requirements of our nation with an additional substantial reserve capacity available for any emergency," he said. "This healthy condition, however, will not last long if imports are permitted to displace the manpower and physical assets of the home industry."

Old story.—Thomas reminded the Senate that he had sought a limitation on imports as far back as last May, when receipts of foreign oil were less than 500,000 bbl. daily, and it was defeated by only a single vote.

"A year ago the flood of foreign oil then entering this country was causing serious injury to the oil producers and economy here at home. We thought imports surely had reached their peak, but they had not," Thomas commented.

Thomas explained that the proposed limitation of 5 per cent on imports is not guess work but is based on the history and experience of the industry itself and would merely "establish a reasonable and equitable relationship between imports and domestic supply."

His bill sets forth as congressional policy "that imports of foreign oil shall not be permitted to displace the domestic petroleum industry or domestic labor thereby causing an ultimate net loss of revenue by reason of contraction of the tax base from which federal revenues are derived," and would place Congress on record as supporting a strong domestic industry "in order to prevent a dangerous and unnecessary dependence by the United States upon foreign sources for supplies of petroleum."

What it provides.—The measure would amend section 3422 of the Internal Revenue Code to provide:

"That under regulations established by the Secretary of the Treasury total imports of crude petroleum and petroleum products shall be limited in any quarter of a year to an amount not to exceed 5 per centum of the domestic demand for crude petroleum and petroleum products in the United States for the same quarter of the previous year as reported by the United States Bureau of Mines, plus crude petroleum and petroleum products purchased abroad for use of the United States Military Establishment. Provided, further, that for the purposes of this subsection imports of crude petroleum and petroleum products shall include crude petroleum and petroleum products purchased abroad for use of the United States Military Establishment and oil for supplies for bunkering vessels at United States ports, but shall exclude crude petroleum and petroleum products imported for manufacture and reexport. Limitations established under this subsection may be suspended during any period of inadequacy of petroleum supplies to meet current national consumption."

Kerr Bill Test

Backers say it will pass this week; Truman neutral

WASHINGTON.—The Senate is expected to pass on legislation this week to exempt independent producers and gatherers of natural gas from Federal Power Commission control.

The measure was brought up for debate last week and precipitated the bitterest fight in which the Senate has engaged this session. The debate was largely concerned with the major issue which has been raised by opponents, that enactment of the legislation would result in a billion-dollar increase to the public in gas rates.

The bill, originally introduced by Sen. Robert S. Kerr of Oklahoma a year ago this month and revised in a substitute introduced last February 1, provides for the exemption from FPC control of arm's-length sales of gas by producers or gatherers.

The revised bill, however, also provided that the FPC should keep current information relative to a determination of whether, by reason of lack of effective competition between producers or gatherers, the flow of natural gas into interstate commerce is being or may be unduly retarded or the price of gas is or will be unduly affected.

Early in the week there was some question whether the bill would be disposed of promptly, since the Senate schedule calls for interruption for action on the O'Mahoney pricing practices bill, which also will be the target of considerable opposition and may require some time for disposition.

Supporters of the Kerr bill were confident they could beat down the opposition and pass the measure, and it was reported that President Truman had agreed not to veto it if it reaches the White House.

British Note

New approach planned in dollar-sterling dispute

WASHINGTON.—State Department officials will meet with company representatives again toward the end of this week to put the finishing touches to a note to be submitted to the British Government outlining the United States' position in the sterling-dollar controversy.

The memorandum is expected to be so couched as to put the British in a position where they will either have to modify the order restricting imports of dollar fuel oil and gasoline into the United Kingdom or in effect admit it was aimed less at a saving of dollars than at freezing the companies out of the sterling area and the domination of the world oil market.

What it will say.—The note is expected to say that the American companies can produce oil with a dollar content no greater than that in the "surplus" sterling oil which Britain is trying to dispose of, and on that basis should have free competitive access to the markets earmarked for British oil.

Further, it will take the position that the companies, meeting all requirements laid down for sterling oil, should be permitted to use at least part of their sterling income without restriction.

The department will also ask Britain to give assurance that the companies will not be limited in their freedom to compete for United Kingdom oil requirements through 1952 and that no further restrictions will be imposed in that period.

One of the problems with which the department is still struggling is that of clearing up the situation in the so-called third countries where the companies are being frozen out by either the restrictions on sterling or bilateral agreements.

The note is expected to ask for the discontinuance of bilateral agreements and similar arrangements, which entirely close markets to the compa-

WATCHING WASHINGTON

Bertram F. Linz

To Bark, Not Bite

Legislation extending the Economic Cooperation Act isn't going to be fitted with dentures to bite back at those who bite the hand that feeds them, and at best will be given a delicate voice with which to whisper gently to the Marshall-plan nations that they shouldn't discriminate against American business.

Sen. Tom Connally of Texas, who earlier this month said he would demand that the European countries sign bilateral agreements to prevent such discrimination, has seen the light of ECA reasoning and will modify his amendment to a mere declaration by Congress that discrimination should not be practiced.

Actually, Connally's original proposal would have put both the Marshall-plan countries and the ECA in a tight box. The latter, which boasts that it scrupulously lives up to every word in the legislation under which it operates, might well have found itself in a position of having to cut off aid to some country which couldn't possibly cope with its dollar-exchange problem except by what would technically, at least, be discrimination against the United States.

Connally's amendment was aimed at Britain, whose activities in the world oil trade had been explored by his Senate foreign relations committee. But ECA officials, who privately might have had some sympathy with the idea, convinced him that it was loaded with dynamite that might blow the whole Marshall plan to pieces.

Rubber Rebound

Administration officials whose plan for disposition of the Government's synthetic-rubber plants was torpedoed by the House armed services committee in favor of a 3-year extension of the present law, are trying to work out some strategy that might save at least the major part of President Truman's program.

Under discussion are the relative merits of holding the legislation off the House floor until the Senate committee can hold hearings and perhaps report out a bill more to the President's liking or of permitting the House to pass the measure and try for amendments in the Senate.

The administration proposals, which would put full control of synthetic rubber in the President's hands for 10 years and provide for preferential treatment in the disposal of the plants to other than the major rubber companies, got short shift in the House committee where, almost at the outset of hearings, Chairman Carl Vinson of Georgia labeled the program unsatisfactory. A majority of his committee went along with him and substituted an extension of the present act for the administration plan.

The major objection to the plan is the insistence of the White House on a small-business approach and the incorporation of a superabundance of guards against possibilities of monopoly, a laudable approach but toward an objective which it is felt in some quarters could as readily have been achieved by the application of existing laws.

Looks Fishy

How would a congressman know that 10 days after he asked House permission to insert it in the Congressional Record he would have a copy of a letter not yet written and which would not be written to him?

Of course, there is a probable and simple answer to this rather intriguing question. The congressman may have been advised this particular letter would be forthcoming and was merely reserving space for it in advance, but to the uninitiated it might look like such prescience on the part of the aforesaid congressman that he should be reelected forthwith.

The whole episode is embalmed in the sober pages of the Congressional Record which relates, March 2, that Rep. Wright Patman of Texas asked leave (six leaves, to be exact) to insert material, and then, March 13, that Patman in an extension of remarks of March 2, inserted a letter dated March 8 from former Federal Trade Commission Chairman Robert E. Freer to Rankin P. Peck, president of the National Congress of Petroleum Retailers.

Freer's letter condemned the O'Mahoney bill to permit sellers to quote delivered prices and absorb freight, and Patman, who has been fighting the bill vigorously and vociferously, put it into the Record the day before the House, hoping it would be the last time, voted on the legislation. But it failed to have any effect and the House refused to reject the measure by a vote of 204 to 175.

nies, but the question of sterling restrictions is more complicated and may be dealt with under the department's first suggestion for the partial lifting of restrictions in the United Kingdom.

The department reportedly will make it clear that the companies are willing to cooperate fully with Britain in its effort to close the dollar gap, even to the extent of operating British subsidies under British requirements, but will not accept any "incentive" plan backed up by a freeze-out.

OGD Rapped

House group asks its end, cuts funds for oil work

WASHINGTON. — Abolishment or substantial reduction of the Oil and Gas Division was recommended to Congress this week by the House appropriations committee.

Reporting the omnibus appropriation bill carrying the funds to be made available to all federal agencies except the Economic Cooperation Administration during the fiscal year beginning next July 1, the committee asserted there is no need for the OGD but did not deny funds for its continuance. The budget provided $198,825 for its general work, against $169,500 for this year.

The committee pointed out that the division was established after the war to continue certain functions previously performed by the Petroleum Administration for War.

"There was need to have active government cooperation with the petroleum industry during the period of maldistribution of oil products just after the war," it asserted, "but the committee is cognizant of no such condition or need at present. Therefore, the Oil and Gas Division should be either abolished or substantially reduced. Specialists in the petroleum field can be made a part of the program organization to advise the Secretary of the Interior on policy and coordination of those matters for which the department is responsible by law."

An increase of $25,000, $5,000 less than requested, was approved for enforcement of the Connally Hot Oil Act, for which $200,000 is to be provided.

Increases of $235,390 were denied the Bureau of Land Management, which is given $884,210 for the lease and disposal of lands and resources, but the Geological Survey was given $3,084,600 of the additional $3,500,000 requested, and will have $4,445,000 for geologic and mineral resources work and $850,000 for administration of mineral leases.

The committee sharply criticised the Bureau of Mines for its budget presentation, which it said "defies all efforts to ascertain comparative

costs of the various activities which it is engaged in," and refused some $300,000 in increases for oil and gas investigations, holding the appropriation to the $690,000 provided for this year. It did, however, provide an increase of $200,000 for the synthetic-fuels program, $16,000 less than requested.

The bill also carries $4,000,000 for the Navy for operation of the Naval Petroleum Reserves, a cut of $5,500,000 from the current appropriation which was provided in the budget.

Leasing Hearing Dropped

WASHINGTON.—The Interior Department has abandoned plans for a public hearing on its proposed new lease form, originally set for December 1 at Denver, and has announced that interested parties will be given 30 days in which to file their views with the Bureau of Land Management.

Department officials declared that no major criticism of the proposed form has been received since details were announced last October, but that, on the contrary, comments, including those of the National Petroleum Council's committee on federal oil and gas leasing, "indicate, in general, favorable reception."

Fuel Policy Proposed

WASHINGTON. — An investigation of the plight of the coal industry, which would also cover petroleum, natural gas, and water power and would lay the basis for an over-all domestic fuel policy, was proposed in the Senate last week by Sen. Francis J. Myers of Pennsylvania.

The "sick" coal industry, Myers told the Senate in introducing his resolution calling for the investigation, can be cured only under a definite policy which will cover oil and natural gas, together with such matters as the production of oil from shale and coal, foreign imports, and our opportunities for stockpiling against a national emergency.

The inquiry would be conducted by the Senate Interior Committee, whose chairman, Sen. Joseph C. O'Mahoney of Wyoming, has also introduced a bill calling for a study of the coal situation.

Myers' resolution would direct the committee to make a full and complete study of the available fuel reserves of the United States and the present and probable future rates of consumption thereof; formulate a national fuel policy to meet the needs of the country in peace and war, to include the use of all fuels and energy resources except atomic energy; to recommend methods of encouraging developments to assure the availability of fuels adequate for an expanding economy and national security, and wrap the whole thing up in a report to the Senate not later than next September 15.

GULF COAST

Louisianans Oppose Cut

BATON ROUGE.—Most Louisiana producers expressed themselves as against another allowable cut at a statewide hearing this week, but Esso Standard Oil Co., largest purchaser in the state, advocated reduced allowables.

Cecil Morgan, vice president of Esso, told the conservation commission that if allowables remain the same that the company's runs to storage will "amount to about 10,000 bbl. a day." He said part of this situation could possibly be relieved by spot sales. However, he added, Esso will be in a "precarious position" if the allowables are raised.

The conservation commission was hearing evidence to set the April allowables. Normally, allowables are set for a 2-month period. However, at last month's hearing only the March figures were set. The allowable was a 40,000-bbl. daily slash as compared to the previous month.

Louisiana's production rose steadily throughout 1949 while other oil states, notably Texas, cut their crude output by considerable amounts. This has caused much adverse comment among Texas oil men.

At last week's Louisiana hearing, most purchasers who testified asked that allowables remain the same. Shell Oil Co., Deep South Oil Co., Sugarfield Oil Co., Sun Oil Co., and Continental Oil Co. were among those advocating no further reduction. Phillips Petroleum Co. asked for no increase in allowables because of "excessively high" gasoline stocks.

Tidelands Organization

GALVESTON. — With Gov. Allan Shivers as keynote speaker, a new organization known as the Texas Property Defense Association, was formed here last week to push the tidelands fight.

Shivers declared that many felt that the issue was of concern only to the oil industry. He said this was not the case but that "this issue is on the bedrock principle of whether the people will retain their inherent power of local self government. As a matter of fact," he continued, "the oil companies do not particularly care who has control of the tidelands. They are more interested in whether they have a valid title."

The governor called attention to the fact that not only oil but shrimp, fish, gravel, shell and oysters are involved. He cited the suit of Solicitor General Perelman claiming that the federal Government not only owns the tidelands, but the ports themselves.

Any citizen of Texas can become a member of the new association by paying annual dues of $1. Herbert Y. Cartwright, Jr., mayor of Galveston and originator of the conference, was elected president.

Galveston was selected as headquarters for the group. A spokesman said that it is expected that Louisiana will soon form a similar association.

Louisiana Files Brief

WASHINGTON. — Louisiana told the Supreme Court this week there is no real conflict between federal and state control of the tidelands.

In a brief on which he will argue the state's side of the tidelands issue when the Government's suit against Texas and Louisiana is heard next week, State Attorney General Bolivar E. Kemp, Jr., denied that the federal Government has any proprietary rights to Louisiana's tidelands, but conceded it has certain responsibilities in the area by reason of sovereignty. However, he added, Louisiana's oil activities in the submerged area have been conducted within the framework of the Government's responsibilities and have not overlapped them.

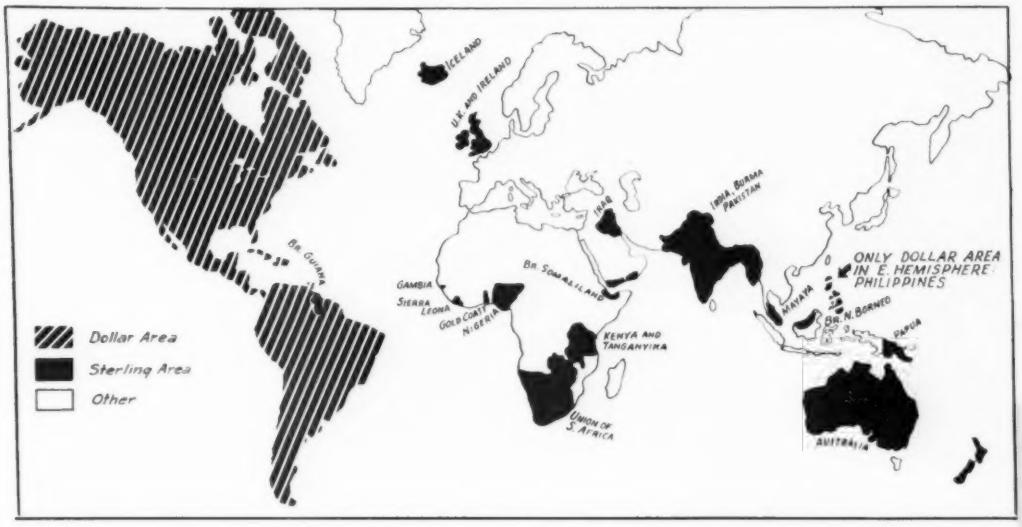
Kemp claimed that the state owned the tidelands under the 1803 treaty by which the United States acquired the Louisiana territory from Spain and under the congressional action of 1812 admitting Louisiana to statehood.

Marsh Island Leasing

BATON ROUGE. — Marsh Island, 75,000 acre wildlife refuge off the Louisiana coast, has been offered for oil leasing by the State Mineral Board. The board also advertised for leasing 10 tracts in the Ship Shoal area, including 20,000 acres in the tidelands. Bids on these and Marsh Island will be opened March 30.

Marsh Island leasing will be controlled by special acts of the Louisiana legislature resulting from the donation of the island to the state by the Russel Sage foundation for use as a refuge. Term of the lease will be $3\frac{1}{2}$ years, with 18 months allowed for initial operations instead of the usual year, because no activity on the island is allowed for the 6-month breeding and nesting period.

The island was previously leased in 1945 to Superior Oil Co., which never developed it although it paid a bonus of more than $500,000 for the rights. The property was offered again for lease last summer, but all bids were rejected as too low. Discovery of a gas-condensate well in Lake Sand field about a mile from the island by Humble Oil & Refining Co. is expected to increase interest in the island.



The Sterling Area

Struggle between sterling oil and dollar oil is now a major factor in international commerce and diplomacy

Dahl M. Duff

THE sterling area and its problems have become a major factor in the oil trade of the world.

The map on this page shows the sterling area in black and the dollar area striped. The so-called third countries, which are neither dollar nor sterling, are left white. But many of them have their currencies more or less tied with the British pound or are so deeply involved with British trading agreements that the results are almost the same as though they were part of the sterling area.

Within and without the sterling area, the British Government has erected a great maze of financial regulations designed to prevent loss of dollar exchange. The British Government acts as banker for the sterling-area countries and at the same time closely controls the transfer of sterling credits elsewhere in the world.

It is within the sterling area that the British, effective February 15, cut imports of American-produced oil by slightly more than 76,000 bbl. daily. Most of this is in the United Kingdom. It has been replaced by British production.

Many restrictions.—Outside the sterling area, the British have numerous bilateral trade agreements. There are more than 40 of these agreements, some with Iron Curtain countries. A supply of oil in exchange for other products is often a part of such arrangements.

Even where oil is not specifically included in these agreements, it is seriously affected. A country such as Argentina cannot use the sterling it obtains to pay for oil from an American production source. British exchange regulations forbid such a transfer of funds.

On the map it is significant to note that neither Iran or Venezuela, the major sources of British production, are a part of the sterling area. In these two countries the British necessarily must spend considerable sums in dollars in connection with their oil operations.

This dollar component of British oil for such expenses as American equipment, royalties, and wages, is an important point in the current dollar-sterling oil problem. It is said to be about 55 cents a barrel in Iran and about $1.50 in Venezuela.

American contentions.—Conceding the urgent British necessity to use their dollars only for the most needed purchases in the dollar area, the American oil companies contend that nevertheless they can supply oil with no greater dollar component than the British companies.

This means they would take sterling in their marketing operations and spend it for services and supplies to the maximum possible in the sterling area. An American company with wide international operations could spread the use of the sterling over a much wider base than only those areas involved in the immediate sterling production and sale.

The entire problem of sterling versus dollar oil grows out of the dislocation of normal patterns of world trade and currencies as a result of the liquidation of British investments, accumulation of huge sterling balances by such countries as India, and the development of new national industries throughout the world. These changes came during and following the war.

The British control a production of some 1,600,000 bbl. daily, about 46 per cent of non-Russian foreign output. The charge has been made that the British Government is attempting to use its oil resources to regain its world trading position regardless of the effect on long-established American operations.

Questions.—Why, it has been asked, does the British Government use high-dollar-cost oil from Venezuela when an American producer in the Middle East could supply this oil with much less dollar drain?

Why, it is asked, does the British Government continue to lean so heavily on oil as an instrument of its national trade policy—a sort of eggs-in-one-basket policy that could be disrupted overnight by world price reductions?

In addition, some observers of the problem consider it contradictory that

the British Government attempts to expand its oil trade with other countries and at the same time spend dollars to meet the petroleum requirements of the sterling area.

These questions illustrate a few of the many ramifications in the overall problem. Economists in the oil industry today find themselves wrestling with matters of world economic policy that in a sense rise above the oil industry itself. For example, to achieve the desired goal of multilateral trade and convertibility, some persons feel that Britain's overseas sterling debts results from the war must be written off or refunded. These are estimated at about $10,000,000,000 and are draining off much of the country's industrial effort.

World Production

Increase in foreign production fails to offset January drop in United States; world output off 54,500 bbl. daily

Dahl M. Duff

A DECLINE in output in the United States, together with an over-all increase in foreign areas, again characterized the crude-oil production trend in the month of January.

United States production was down for the second consecutive month. The January daily average of 4,934,000 bbl. represented a drop of 90,000 bbl. daily, or 1.8 per cent from the previous month.

Against this, foreign production, excluding Russia and Eastern Europe, showed an increase of 35,500 bbl. daily, or slightly less than 1 per cent. A new all-time high in Venezuela and the commencement of production in Qatar in the Middle East were the main factors in this foreign gain.

Estimated world production, including the Russian-controlled areas, dropped back slightly to an average of about 9,535,000 bbl. daily. The 90,000 bbl. daily decline in the United States was only partly offset by the total foreign increase.

Western Hemisphere.—United States production was at its high point of the winter last November with 5,209,500 bbl. daily. It fell to 5,024,000 bbl. daily in December and showed the further decline in January. The January average is 455,000 bbl. daily below the daily average for the corresponding year-earlier month.

Although government-requested reductions have since brought Venezuelan output down sharply, in January it gained 24,600 bbl. daily over December. This increase of 1.7 per cent brought the January daily average to 1,464,900 bbl., a new high for Venezuela. It compares 1,382,800 bbl. daily produced in October 1948 before the decline later in 1948 and in the early part of 1949.

Only slight changes were reported in production in other countries of the Western Hemisphere. In Colombia, government figures showed the following production by concessions in January: De Mares, 1,051,142 bbl.; Barco, 800,501 bbl.; Yondo, 489,636 bbl.; Cantagallo, 37,339 bbl.; Dificil, 110,181 bbl.; and Velasquez, 30,134 bbl.

Official data on Mexican production for the entire year 1949 gave a daily average of 166,401 bbl. This was an increase of 6,920 bbl. daily over the daily average for the year 1948. The 1949 daily average was divided by areas as follows: Isthmus, 17,624 bbl.; Poza Rica, 100,930 bbl.; Southern, 21,062 bbl.; Northern, 25,079 bbl.; and Northeast Mexico, 1,706 bbl.

Europe.—Production in Schoonebeek field in the Netherlands fell off slightly in January to an average of slightly more than 11,000 bbl. daily. This compares to an average of more than 13,000 bbl. daily in November.

Only new information made available recently on Eastern Europe crude production was a report that Albania in 1949 produced an estimated 2,188,000 bbl. This is a daily average of about 6,000 bbl., much higher than previously credited to that Communist-controlled country.

Middle East.—Most significant development in the Middle East area was the beginning of production in the Persian Gulf shiekhdom of Qatar. Dukhan field is a major Middle East oil reserve, and the drilling in progress there since the war cultimated in the first export early this year. Shipments were made possible by the completion of a 73-mile pipe line across the base of the peninsula. Qatar is expected to produce about 2,000,000 tons of crude this year, or a daily average of 40,000 bbl.

As a result of Qatar's production, output in the Middle East for the first time went above the 1,500,000 bbl. daily mark. The January total of 1,505,700 bbl. daily represented a gain of about 16,000 bbl. daily over the December daily average.

Far East.—Japan's crude-oil production in January was at a new postwar high of about 5,000 bbl. daily. The increase was due to the new production which has been found recently in Yabase field with the assistance of American technicians. The January total in Japan was estimated at 154,105 bbl. by Leo W. Stach, of the occupation headquarters.

CRUDE-OIL PRODUCTION
(Thousands of barrels daily)

Country—	Jan. 1950	Dec. 1949	Jan. 1949
Western Hemisphere:			
Argentina	61.0	60.8	65.0
Bolivia	2.2	2.1	1.5
Brazil	0.6	0.4	0.4
Canada	57.5	56.9	43.7
Chile	2.0	2.2	
Colombia	81.3	82.4	75.5
Cuba	0.6	0.6	0.3
Ecuador	7.2	7.2	7.0
Mexico	174.2	179.9	157.3
Peru	41.0	40.7	39.5
Trinidad	55.8	55.8	55.7
Venezuela	1,464.9	1,440.3	1,251.0
Total	1,948.3	1,929.3	1,696.9
Europe and Africa:			
France	1.3	1.3	1.1
French Morocco	0.8	0.8	0.4
Germany	18.4	18.4	13.4
Italy	0.2	0.2	0.2
Netherlands	11.1	12.0	11.4
Egypt	45.5	44.9	36.1
United Kingdom	0.9	0.9	0.9
Total	78.2	78.5	63.5
Middle East:			
Bahrein	30.6	30.3	30.5
Iran	598.7	603.6	539.7
Iraq	115.5	122.2	53.5
Kuwait	275.0	271.1	210.6
Qatar	36.0		
Saudi Arabia	449.9	462.4	523.9
Total	1,505.7	1,489.6	1,358.2
Other Asia:			
British Borneo	72.0	72.0	60.4
Burma	0.5	0.5	0.5
China	1.5	1.5	1.8
India	5.5	5.5	5.3
Indonesia	122.5	122.5	108.5
Japan	5.0	4.3	2.6
New Guinea	4.8	4.8	4.4
Pakistan	2.5	2.5	1.0
Total	214.3	213.6	184.5
Total foreign, less Russia and E. Europe	3,746.5	3,711.0	3,303.1
Russia and E. Europe:			
Austria	22.0	22.0	17.5
Romania	82.0	82.0	95.0
Yugoslavia	1.2	1.2	1.1
Russia	730.0	730.0	625.0
Other E. Europe	19.1	19.1	14.0
Total	854.3	854.3	752.6
Total foreign	4,600.8	4,565.3	4,055.7
United States	4,934.0	5,024.0	5,389.0
World total	9,534.8	9,589.3	9,444.7

Figures are authoritative for the Middle East and the more important producing countries of the Western Hemisphere and Europe. Estimates have been made in other cases based on previous months; previous-month figures heretofore shown have been revised where better information was available. Data for Russia and Eastern Europe are estimates only, reflecting what is believed to be current production.

TREND OVER THE LAST YEAR

	W. Hemisphere less U. S.	Middle East	Foreign less Russia and E. Europe
February	1,688.6	1,400.2	3,340.2
March	1,625.9	1,393.4	3,280.2
April	1,678.2	1,485.2	3,388.3
May	1,768.5	1,417.6	3,472.8
June	1,768.8	1,375.7	3,433.3
July	1,800.2	1,338.7	3,428.1
August	1,859.9	1,323.9	3,473.1
September	1,931.8	1,351.5	3,574.9
October	1,921.6	1,428.6	3,645.9
November	1,925.9	1,472.7	3,683.0
December	1,929.3	1,489.6	3,711.0
January	1,948.3	1,505.7	3,746.5

Tetuan Development

The Texas Petroleum Co., Colombian Division, has commenced a second well near its recent Tetuan discovery in the Upper Magdalena Valley.

Latest report was that Tetuan 2 had cemented 8⅝-in. at 375 ft. It is located about 600 m. southeast of the discovery.

The Tetuan discovery was the first success in Colombian wildcatting in about 3 years. The well went to a total depth of 4,579 ft. It is reported good for production of about 150 bbl. daily of 22°-23°-gravity crude. Discovery location was about 13 miles northwest of Ortega.

Venezuelan Cut

February output 145,718 bbl. daily under January

VOLUNTARY action of the producing companies in Venezuela reduced February crude-oil production in that country to its lowest level since the middle of last summer.

The extent of the government-requested reductions has been disclosed in figures released by the Ministry of Fomento. They show a drop in output from January to February of 145,718 bbl. daily.

Of this total, approximately 72 per cent was accounted for by Creole Petroleum Corp. Bearing out previous predictions, total production in the country in February at 1,319,154 bbl. daily was only slightly above the 1,300,000 bbl. daily mark. This compares to an all-time record high production of 1,464,872 bbl. daily in January.

The Venezuelan Government asked the producing companies to lower their output because of the pressure on Congress in the United States for higher taxes on imported oil.

The table shows that practically all the major producing companies in Venezuela shared in the January-February reduction. In the case of Richmond Exploration Co., its low-gravity Boscan field has been virtually shut in for several months, and production was stepped up because of the summer demand for road-surfacing material.

Venezuela has been further alarmed in recent weeks over the new turn in the import situation which has resulted in reports that the United States-Mexico trade agreement, under which the oil tariff was generally reduced to 10½ cents, may be replaced. Dr. Gustavo Thery Fombona, acting head of the Ministry of Fomento's Hydrocarbons Bureau in the absence of Dr. Jose Martorano Battisti, is reported to be in Mexico in connection with this aspect of the matter.

VENEZUELAN PRODUCTION BY COMPANIES
(Figures in barrels daily average)

Company—	Jan.	Feb.	Change
Creole	667,810	584,695	—83,115
Shell Group	457,261	438,810	—18,451
Mene Grande	196,074	165,690	—30,384
Socony-Vacuum	37,123	26,466	—10,657
Texas	35,052	22,784	—12,268
Atlantic	19,977	23,133	+3,156
Mercedes	17,250	16,928	—322
Sinclair	13,048	13,609	+561
Pantepec	12,618	13,153	+535
Phillips	7,069	7,746	+667
Richmond	461	4,962	+4,501
British Controlled Oilfields	1,014	1,093	+79
Guasare	105	85	—20
Total	1,464,872	1,319,154	—145,718

Isthmus Line Started

WASHINGTON.—Construction of the new Petroleos Mexicanos 155-mile pipe line across the Isthmus of Tehuantepec has commenced, it was announced this week by Sen. Antonio J. Bermudez, director general, through his Washington information office.

The laying of the line has started and completion is scheduled for next October. The 10-in. pipe will have a daily capacity of 30,000 bbl. of gasoline, kerosine, and diesel oils and will cost approximately $3,427,000 in the equivalent of U. S. Currency.

The first 47 miles of the line were built by Pemex engineers and crews and the remainder is being constructed by two private contractors, Gonzalez Ballesteros, S.A., and Compania Constructora El Aguila, S.A., which built part of the line from Poza Rica field to the new Salamanca refinery.

Construction of the line will be a difficult undertaking, Bermudez said, since it will traverse swamps and dense jungles at one end and rugged hills at the other.

Bermudez pointed out, however, that it will enable railroad tank cars now hauling products from the Minatitlan refinery on the Gulf of Mexico to the Pacific port of Salina Cruz to be freed for the transportation of Bunker C fuel oil along the same line; quick loading of tankers at Salina Cruz to supply west coast Pemex terminals will be facilitated, and in the event both Atlantic and Pacific shipping lanes may become hazardous the pipe line will afford a quick and safe means for east-west movements of oil between both Mexican and United States points.

Pipe-Line Bids Asked

The Antioquia Railroad in Colombia has asked for bids for the construction of a 113-mile products pipe line from Puerto Berrio to Medellin.

The invitation notice said that preference is for 5 and 6-in. pipe and pumps. Offers should be submitted to Dr. Nicolas Bernal B., superintendent general, Ferrocarril de Antioquia, Medellin.

The line would handle products brought to Puerto Berrio through the existing 60-mile, 6-in. line of Tropical Oil Co. from the Tropical refinery at Barranca Bermeja.

The Medellin line has long been a project to improve present distribution of petroleum products in Colombia. The Antioquia Railroad is a state-owned agency, and transportation costs by rail over the route now approximate 12 cents a gallon.

The pipe-line route rises from an elevation of only a few hundred feet at Puerto Berrio on the Magdalena River to nearly 6,000 ft. crossing the Central Cordillera and drops down to about 5,000 ft. at Medellin. Medellin is the principal manufacturing center of Colombia.

The line was one those recommended for construction in the report on the Colombian oil industry which was made to the Colombian Government by Foster Wheeler Corp. Another recommended pipe-line project in Colombia is that from Puerto Berrio to Salgar, the railhead for Bogota. This line is reported to have been contracted by the consulting and construction firm of Acosta & Madero Paris, and is awaiting allocation of funds.

MIDDLE EAST

Haifa-Aqaba Line Talked

The question of the construction of a crude-oil pipe line from the head of the Gulf of Aqaba to Haifa has been revived in Israeli Government circles with the continued shutdown of the Haifa refinery.

The line would be constructed to circumvent the blockade of petroleum from the Arab states to the Shell-Anglo-Iranian plant. The plant of about 83,000 bbl. daily capacity has been closed down about 2 years.

Saudi Arabia prevents lifting of oil destined for Israeli, Iraq refuses to allow use of the Kirkuk line to Haifa, and Egypt denies use of the Suez Canal to such shipments. The Gulf of Aqaba runs into the Red Sea. Direct distance from Aqaba to Haifa is about 260 miles.

Such a project would be a major undertaking. The Israeli Government announcement that the line was under "serious consideration" was taken with considerable caution.

In Haifa, the refinery management announced the plant would be placed on a caretaking basis and most workers dismissed by June. In Bagdad, the Iraqi economics minister told parliament that the Iraq policy against pumping oil to Israeli was unchanged.

PERSONALS

New Appointment

Jarvis named to Creole's management committee

HARRY A. JARVIS, who has been manager of the refinery department of Creole Petroleum Corp. since 1949, has been appointed a member of the management committee of the company.

Jarvis is a veteran official on the processing side of the oil industry of South America. He has been employed by Creole in Venezuela since January 1947 when he was named assistant manager of the refinery department. In 1948, he was manager of the Creole refinery project at Amuay Bay on Paraguana Peninsula in northwestern Venezuelan. This 60,000-bbl. daily plant was completed and on stream early this year.

At 41, Jarvis has nearly 20 years of experience in the oil industry, almost all of it in South America. He was graduated from the University of Maryland in 1930 and soon joined the Standard Oil Co. (N. J.) organization at its Bayway, N. J., refinery.

He worked at the Bayway refinery only about 7 months before leaving in February 1931 for Argentina where he began his career in South America as a junior engineer at the Campana refinery of Cia. Nativa de Petroleo, a Jersey Standard affiliate. He ultimately rose to the position of president and general manager of this company. Jarvis' home town is Berlin, Md.

Robert L. Bigard, formerly driller in the Stettler, Alta., Canada, area for Parker Drilling Co., has been transferred in the same capacity to the Snyder, Tex., area.

W. N. Wheatley, formerly coordinator of field construction in the Tulsa office for Stanolind Oil & Gas Co., has been named supervisor of construction for the firm's Fullerton gasoline plant, Andrews, Tex. **Edward G. Hassler,** petroleum engineer at Beaumont, Tex., has been transferred to Brownfield, Tex., in the same capacity; and **William R. Chadwell,** formerly engineer at the Fullerton gasoline plant, has been named shift foreman at the company's North Cowden gasoline plant.

John S. Goodrich, formerly at Imperial, Tex., for Magnolia Petroleum Co., has been named production foreman at Snyder, Tex. Other changes include: **John R. Leonard,** engineer in charge of construction of the firm's Hickok, Kans., gasoline plant, transferred to Duncan, Okla., in charge of construction of the Chitwood gasoline plant; **Norris N. Requist,** geologist at Oklahoma City, transferred to Oklahoma City in that capacity; and **Kent D. Spaulding,** engineering trainee at Duncan, Okla., transferred to Opelousas, La.

E. B. Woodell, assistant superintendent for Humble Oil & Refining Co. at the Katy, Tex., gasoline plant, has been named superintendent of the firm's gasoline plant at Jourdanton, Tex., and **F. V. LaFayette,** gas-plant superintendent at Genoa, Tex., has been transferred in that capacity to Conroe, Tex.

R. C. Cashin, geological engineer, and **George H. Fentress,** geologist, for Phillips Petroleum Co. at Port Gibson, Miss., have been moved in similar capacities to Marshall, Tex.

W. O. Waid, district foreman at Ville Platte, La., for Continental Oil Co., has been transferred to the East Texas district, with headquarters at Tyler, as district engineer. **Paul N. Colliston,** formerly petroleum engineer and geologist for the A. G. Carter Foundation, Kermit, Tex., has joined Continental as proration engineer with headquarters in Houston.

W. E. Reed, Kansas superintendent for Stovall Drilling Co., Inc., has been sent to Monroe, La., in the same capacity.

Frank H. Holcomb, Illinois manager for Tex-Harvey Oil Co., Salem, Ill., has been transferred to Midland, Tex., as manager, and **J. E. Page,** superintendent of drilling and production at Salem, Ill., has been transferred to Angus, Tex.

L. D. Bechtel, field superintendent in the Oregon Basin for Ohio Oil Co., Cody, Wyo., has been transferred to Lovell, Wyo., as district superintendent.

J. R. Bozeman, independent oil producer at Shreveport, has moved to Midland, Tex.

L. A. Webster, superintendent of the Burrton, Kans., plant of Cities Service Oil Co., has been transferred to Guymon, Okla., as superintendent of the company's gasoline plant.

J. W. Nickson, Rankin, Tex., is now serving as rotary driller for Shell Oil Co. in the Monahans, Tex., area.

J. M. Fouts, Jr., area geologist at Houston for Shell Oil Co., has been transferred to the Los Angeles office as geologist for Pacific Coast region. He joined Shell as an engineer trainee in Houston in 1939, and later served as junior engineer and senior exploitation engineer in Texas. He was appointed geologist in Houston in 1948. Fouts holds a master's degree in geology and petroleum engineering from University of Texas.

C. A. Davis, production engineer at Los Angeles for Richfield Oil Corp., has been transferred to Bakersfield, Calif., as division production engineer.

Nathaniel S. Terry, geologist for the Los Nietos Co. at Midland, is now serving as geologist for **Patrick A. Doheny,** oil operator.

William B. Estill, engineer at Manhattan, Kans., for Kanotex Refining Co., has been moved to Arkansas City, Kans., in the same capacity.

H. Melvin Crist, formerly superintendent, New York division, Susquehanna Pipe Line Co., is now serving as area superintendent at Oxford, Miss., on temporary assignment with Mid-Valley Pipeline Co.

Francis Ringer, assistant measurement superintendent at Eagle, Pa., for Texas Eastern Transmission Corp., has been transferred to New York City as technical supervisor of gas measurement and corrosion control.

John A. Jones, Tulsa, has joined National Associated Petroleum Co. at Mount Vernon, Ill., as engineering trainee.

D. A. Ross, consulting geologist at Corpus Christi, has moved to Midland, Tex.

R. P. Hargis has been named president of Premier Oil Refining Co. of Texas, and general manager of Premier Petroleum Co., succeeding **Sylvester Dayson,** who resigned.

J. R. HARRISON

John R. Harrison has been appointed district manager in charge of maintenance and construction in the Owensboro, Ky., district for Texas Gas Transmission Corp., and **Ralph W. Thacker** has been named supervisor of payroll and office service manager. Harrison has been with Texas Gas since 1946, and has worked in the compressor-station, pipe-line, and dispatching departments prior to his new appointment. Thacker joined the company in 1949.

George L. Parkhurst, vice president, Standard Oil Co. of California, and **Dr. M. E. Spaght,** president, Shell Development Co., have been named to the newly formed technical advisory committee of Stanford Research Institute.

Robert L. Reed, New York City, has been named managing director of Roxana Oil Co., Ltd., Calgary, Alta., Canada.

J. R. Nichols, superintendent of Humble Oil & Refining Co.'s Conroe, Tex., gasoline plant, has been transferred in the same capacity to the Picton, Tex., plant, and **R. O. McCarty,** engineer at Corpus Christi, has been moved to New Orleans in that capacity.

Don D. Baremore, tool pusher at Kermit, Tex., for Sharp Drilling Co., has moved to the North Snyder, Tex., field in the same capacity.

Leland E. Wilson, Tulsa, has joined Atlantic Refining Co., Odessa, Tex., as engineering trainee, and **Lloyd C. Taylor,** formerly production foreman at Great Bend, Kans., has been transferred by the company to County Line, Okla., as drilling engineer.

Clayton L. Creager, exploration engineer for Shell Oil Co. at Elk City, Okla., has been moved to Great Bend, Kans., as district engineer.

Archie L. Holland, Jr., field petroleum engineer at Kermit, Tex., for Gulf Oil Corp., has been transferred to Goldsmith, Tex., as area petroleum engineer, and **Roy A. Payne,** geologist at Houston, has been transferred temporarily to Pittsburgh.

Donald L. Bohannan, petroleum engineer at Casper, Wyo., for Rio Bravo Oil Co., Ltd., has been transferred to Edmonton, Alta., Canada, in that capacity.

D. K. Davis, tool pusher at Arcadia, La., for Penrod Drilling Co., is now serving in that capacity in the Haynesville, La., area.

E. M. Pincomb, seismic party chief for The Texas Co. at Alexandria, La., has been moved in that capacity to the Longview, Tex., area.

A. D. Poulk, formerly administrative assistant for Texas Gas Transmission Co., Houston, has been transferred to Owensboro, Ky., as chief clerk in the compressor department.

Fred Ashford, Jr., is now serving as field engineer at Lafayette, La., for Texas Pipe Line Co.

D. D. Cash, tool pusher at Taft, Calif., for Rocky Mountain Drilling Co., has been moved to Dominguez, Calif., in that capacity.

E. H. Beckmann, scout for Pure Oil Co. at Corpus Christi, has been transferred to the company's New Orleans office as landman.

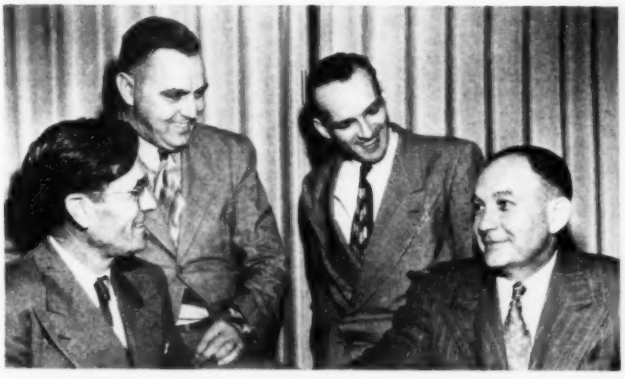
Fred B. Bayless has been appointed drilling superintendent for the West Texas - New Mexico area, Big Chief Drilling Co., with headquarters in Odessa, Tex. Bayless studied mechanical engineering at Texas A. & M. College and in 1936 joined Gulf Oil Corp.'s production department. He went with Phillips Petroleum Co.'s drilling division in 1938, and in 1943 became drilling engineer at Oklahoma City. Since 1947 he has been West Texas district drilling superintendent for Phillips.

Max A. Palmer, Tulsa, has joined British American Oil Co. at Toronto, Ont., Canada, as process engineer.

Max Bailey, driller at Graham, Tex., for Basin Drilling Corp., is serving in that capacity at Jacksboro, Tex.

M. L. Morris, general drilling superintendent at Elmore City, Okla., for Sohio Petroleum Co., has been moved to Pauls Valley, Okla., as superintendent of production and drilling operations.

Ralph E. Deeds, technical assistant in the refining and oil-movement department, Esso Standard Oil Co. refinery, Baton Rouge, La., has been promoted to assistant general fore-



NEW OFFICERS, KANSAS CHAPTER, A.A.O.D.C.—Above are newly elected officers of the Kansas Chapter, American Association of Oilwell Drilling Contractors. Left to right: J. G. Adkins, Adkins Drilling Co., Great Bend, vice chairman for Central Kansas; E. L. McCartney, B. & R. Drilling Co., Inc., vice chairman for the Wichita area; B. W. Burks, Derby Drilling Co., secretary; and C. H. Todd, Rine Drilling Co., chairman. Todd succeeds Heber Beardmore, Jr., of Beardmore Drilling Co., first chairman of the Kansas chapter.

PERSONALS

TEXACO SAFETY AWARD.—C. A. Miller, left, manager in charge of safety for The Texas Co.'s southern division, presents the Texaco Safety Award to W. C. Kneale, center, manager, South Texas division, producing department. E. R. Filley, general manager of the producing department, stands beside the Texaco President's Award, which was won for the first time by the producing department in 1949 for showing the greatest improvement in injury-frequency rate. Kneale's division won the award over five other divisions of the department.

man in the refining division. Other changes include: **William R. Wuestenfeld,** formerly on the general superintendent's staff, named to replace Deeds in the oil-movement division; and **Alfred F. Roach** and **Robert Ihrie,** formerly in the process-engineers division, transferred to the general superintendent's staff.

E. J. Deupree, California Co., New Orleans, has been named assistant general manager of the production department. Other changes include: **G. N. Hile,** named manager, gas-plant operations, production department, New Orleans; **E. M. Kipp,** named chief engineer, production department, New Orleans; **C. P. Besse,** named assistant chief engineer, production department, New Orleans; **G. M. Liljenstein,** named assistant chief engineer, production department, New Orleans; **A. L. Vitter, Jr.,** named assistant chief engineer, production department, New Orleans; and **J. W. Desmond,** southern exploration division, transferred to Brookhaven.

Frederick F. Dueser, engineer for Republic Natural Gas Co. at Ellinwood, Kans., has been transferred in the same capacity to Dallas.

James A. Price, division manager in Midland, Tex., for Bay Petroleum Corp., has resigned from the company.

Sam Zimmerman has transferred from Carter Oil Co. at Denver, to Arabian American Oil Co. as senior geophysicist at Dhahran, Saudi Arabia. Prior to joining Carter, Zimmerman was chief geophysicist for Standard Oil Co. of Egypt, Cairo.

Dr. Oscar E. Wagner, Jr., has resigned as research geologist for Mid-Continent Petroleum Corp. and has joined Wilcox Oil Co. as geologist in Tulsa. Prior to joining Mid-Continent in 1942 Wagner was with The Texas Co. as district geologist.

Robert D. Gensch, Wichita geological department, Cooperative Refinery Association, has been transferred to Great Bend, Kans., as district engineer for West Kansas. Other changes include: **John H. Nation,** superintendent of production at Bartlesville, Okla., transferred to West Kansas district in Great Bend as production superintendent; **William B. Nation,** district engineer, East Kansas area, Wichita, transferred to Bartlesville as production superintendent; and **Jim Robinson,** material and supply clerk at Bartlesville, moved to Great Bend as district clerk.

J. E. McCall, district geologist at New Orleans for the California Co., has been transferred to Shreveport in the same capacity. Others moved to the newly established Shreveport office, combining the New Orleans and Monroe, La., staffs, include: **S. K. Frazier, J. M. Henton, L. L. McCormick, H. W. Carlson,** and **W. D. Lynch,** geologists; and **H. S. Thompson, Blair Buchanan,** and **William Conrad,** landmen .

William L. Nolan has been elected president of Seminole Oil & Gas Corp., Dallas. He has been on the company's board of directors the past year, and succeeds the late Thomas B. Wright, who died February 26.

DEATHS

Wyllys G. Hooper, 69, vice president and director of Midwest Piping & Supply Co., Inc., St. Louis, died March 11.

William R. Kepler, 64, refinery equipment and pipe-line transmission engineer, died March 11 in Milwaukee. With A. O. Smith Corp., he aided in development of that firm's pipe mill and did extensive development work on pressure vessels for oil refineries.

Edgar E. McWhiney, 68, for many years employed as a secretary in the New York City office of Cities Service Oil Co., died in Westfield, N. J., March 11.

J. M. Kelley, 66, retired engineer for Sinclair Oil Co., died in Shawnee, Okla., March 12.

Horace W. Bunkley, 39, foreman in the lubricating-oil department, Shell Oil Co.'s Deer Park, Tex., refinery, died in Pasadena, Tex., March 13.

Charles J. Geizendanner, Sr., retired executive of The Texas Co., died in Houston March 13.

Frank M. Miller, 92, early-day employe of Standard Oil Co., died in Cleveland March 17.

Lester Taylor Swan, 62, retired drilling contractor, died in Tulsa March 20.

Samuel Levi Poteet, 66, formerly with Lion Oil Producing Co., Fort Smith, Ark., died in Tulsa March 20.

THIS 40-page section prepared by the Journal's refinery-engineering staff presents important and representative modern refining processes. For the most part these numerous techniques involve some form of upgrading or quality improvement of product.

This emphasis on higher quality characterizes the industry today. During the past 3 years well over 1½ billion dollars have been spent in the most significant construction program in refining history. While national capacity was upped to meet sharply expanded postwar demand, the greater part of the investment went into units producing higher-octane gasolines, better diesel fuels, improved burning oils, and more highly refined lubricants.

The present high level of product standards is by no means static. Continued pressure of competition in quality will mean a progressive improvement in specifications in the foreseeable future. This will be attained by wider use of existing methods and by adoption of new processes now in various stages of development.

In the realm of new processes, the refiner will find the means for maintaining or bettering his position in the quality race. But emphasis also is on efficiency, economy, and flexibility; all aimed at reducing investment in relation to capacity and operating costs. This is particularly true in catalytic cracking, catalytic reforming, sulfur treating, and fractionation.

Research and development—the basis for vast wartime and postwar refining growth—are now being given new impetus. Facilities to carry on this basic work exceed those of any other industry. This assures that refiners will be provided with steadily improved processes.

Progress in refining, dominated by the needs of millions of consumers everywhere, is continuous—a fact never more apparent than now.

George A. Weber
Refining Editor.

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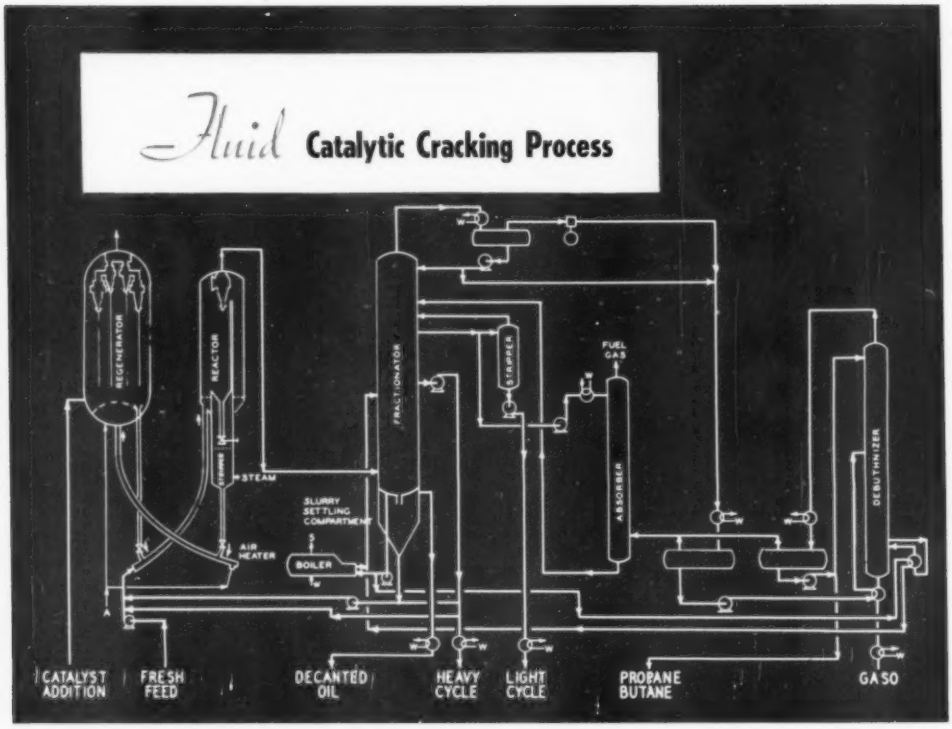


THE fluid catalytic cracking process differs from other catalytic cracking processes in that the finely divided solid catalyst, when sufficiently aerated, behaves like a liquid. The catalyst is conveyed by air or hydrocarbon vapor, the catalyst being dispersed in the flowing gas.

In the reaction vessels, the gas and powder pass through distribution grids into the beds of catalyst which form at the gas velocities obtaining in the vessels. Small amounts of catalyst which escape from the beds with the vapor are collected in cyclones and returned to the beds.

Regeneration

In the regenerator the coke, which is deposited on the catalyst as a byproduct of the cracking reaction, is removed by combustion with air. A blower supplies this combustion air, a portion of which is used to convey the catalyst to the regenerator.

Liquid oil feed is injected into the reactor inlet wherein it meets the stream of regenerated catalyst from the regenerator. The catalyst contains sufficient heat from coke combustion to vaporize oil and supply the heat required by the cracking reaction.

After cracking, the spent catalyst, containing coke and hydrocarbons, is stripped of the latter by steam in the stripper. The catalyst is fed to the stripper by means of a standpipe and controlled slide valve, both located inside the stripper. The stripped vapors are vented back into the vapor space over the reactor bed. The cracked vapors flow to the fractionator tower for product separation.

Adaptability

The fluid process is adaptable to a wide variety of feed stocks ranging from light virgin gas oils to heavy deasphalted reduced crudes and coker gas oils. Typical yields illustrating current operating trends are given in the accompanying table.

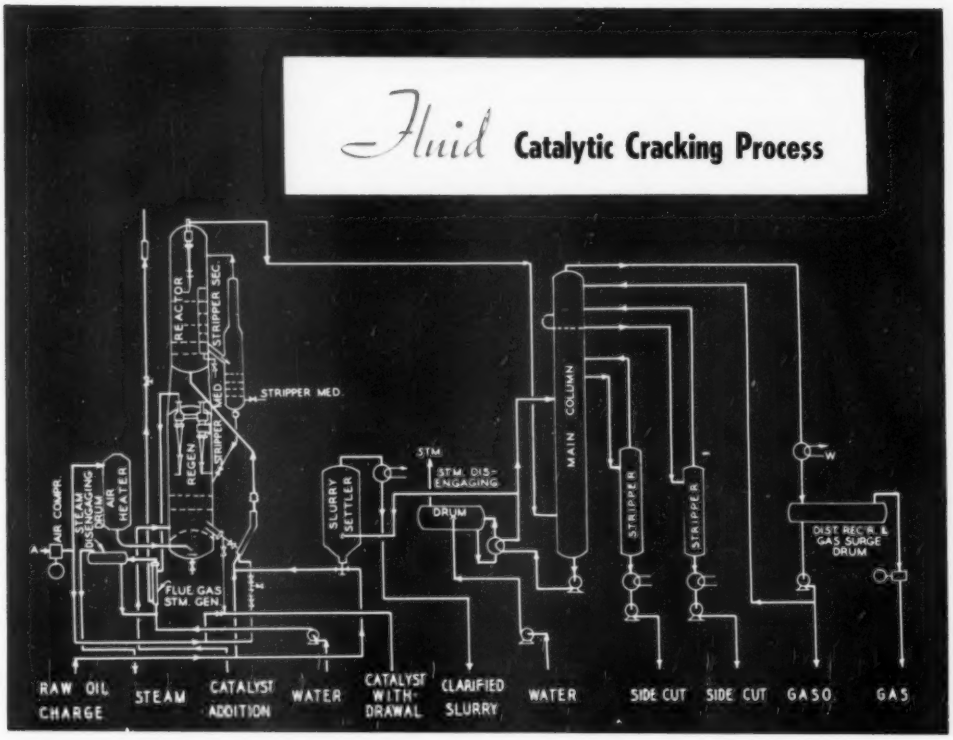
PRODUCT YIELDS OF RECYCLING FOR INCREASED CONVERSION WITH SYNTHETIC CATALYST

Charge: Wide cut Mid-Continent gas oil.

Recycle, per cent of fresh feed	0	50
Conversion, volume per cent of fresh feed	50	65
Product yields:		
Coke, weight per cent	3.2	5.2
Dry gas, weight per cent	5.8	8.2
Butane-butenes, volume per cent	11.8	16.1
Debutanized motor gasoline, volume per cent	38.0	47.3
Total cycle oil, volume per cent	50	35
10-lb. R.v.p. motor gasoline, volume per cent	40.6	50.2
Excess butanes, volume per cent	9.2	13.2
Octane numbers:		
A.S.T.M.—clear	82.0	82.1
C.F.R.R.—clear	95.1	95.1
Total cycle oil:		
Gravity, °A.P.I.	26.3	24.4
A.S.T.M. 50 per cent point, °F.	604	584

Discussion on this process was supplied by M. W. Kellogg Co., New York.

Fluid Catalytic Cracking Process



THE U.O.P. fluid catalytic cracking process is adaptable to the needs of large and small refiners. Units designed in capacities ranging upward from 2,600 bbl. a day, can be built and operated at costs comparing favorably with the cost of thermal cracking units of comparable capacity.

The process is flexible both as to charging stock and products. It can successfully crack kerosine, light or heavy gas oil, and some types of reduced crude. The process produces gasoline of a different character from that produced by thermal cracking. It can be operated to produce either aviation gasoline, high-grade motor gasoline, or raw materials for the production of chemicals and synthetic rubber.

The latest type unit can utilize either synthetic or natural catalyst. In its most simple design synthetic catalyst which has a microspherical form is used. Because of the spherical shape of the particle and its greater strength as compared with the ground powdered catalysts used during the war, this catalyst has very low erosion and attrition rates. In addition, the microspherical catalyst is much more uniform in particle size than the ground catalyst.

Because of the reduced formation of fines by attrition, plants using microspherical catalyst can dispense with secondary catalyst recovery on the gas from the regenerator while still maintaining a low catalyst loss.

Economic consideration of market requirements and operating costs will govern the choice of catalyst. The silica-alumina catalyst gives the highest octane number but a lower gasoline yield, while somewhat more gasoline having a lower octane number is produced from the natural catalyst.

Principal modifications in the new improved unit as compared to the earlier design are:

1. In the small-size units the reactor and regenerator have been combined in a single tower which is erected as a self-supported column. The heavy structure required in the earlier units has been eliminated.

2. The large regenerator riser has been eliminated and the regenerator standpipe has been considerably shortened. There has been a general reduction and simplification of small piping.

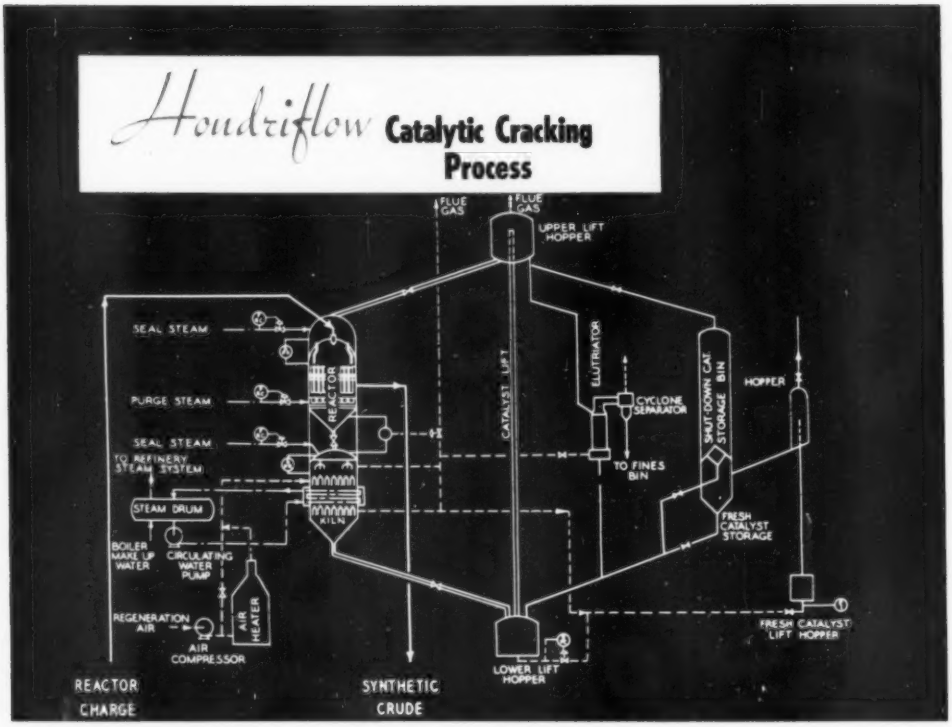
3. Efficiency of the reactor has been improved by the use of additional distribution grids.

4. The air supplied for combustion passes through the regenerator countercurrent to the catalyst. This permits multistage stripping and more complete utilization of oxygen.

FLUID CATALYTIC CRACKING 31° A.P.I. MID-CONTINENT GAS OIL (SILICA-ALUMINA CATALYST) PILOT-PLANT RESULTS

Operation—	Once through	Recycle
Conversion, per cent	60	75
Yields, volume per cent, debutanized gasoline	45.0	53.0
Cycle oil	40.0	25.0
Butylenes	5.8	7.1
Butanes	8.7	9.4
Propylene	5.2	6.4
Propane	2.4	3.3
C_2 and lighter gas, weight per cent	2.5	3.1
10-lb. R.v.p. catalytic gasoline	47.4	55.8
10-lb. R.v.p. polymer gasoline	8.0	9.9
Total 10-lb. R.v.p. gasoline	55.4	65.7
Octane numbers of 10-lb. catalytic gasoline:		
Motor method, clear (F-2)	81.8	81.8
3 cc. TEL per gallon	86.8	87.4
Research method, clear (F-1)	93.7	94.2
3 cc. TEL per gallon	98.7	99.1

Discussion on this process was prepared by its licensor, Universal Oil Products Co., Chicago.



THE recently developed Houdriflow catalytic cracking process employs the moving-bed principle. While this process retains desirable features from the Thermofor catalytic cracking process (licensed by Houdry Process Corp. since 1941), it differs in four major design respects:

1. Method of transporting catalyst.
2. Range of catalyst circulation rates available.
3. Simplification of regenerator.
4. Physical arrangement of principal vessels.

The four major new features of the Houdriflow design are as follows:

Flue-gas lift.—This system transports pelleted or bead catalyst from the bottom to the top of the unit, replacing the bucket-type elevator of the conventional T.C.C. process. Utilization of the lift removes the practical limitation on catalyst circulation rate imposed by bucket-type elevators, making available a wide range of circulation rates, and simplifies the means of transporting catalyst, eliminating mechanical devices.

Catalyst-to-oil ratios.—These run in the range of four to eight whereas conventional T.C.C. units operate in the range of two to three due to elevator-capacity limitations. This range of catalyst-to-oil ratios permits operation with stocks from 0 to 100 per cent vaporized and a reduction in the amount of reactor feed-preparation equipment, since a major portion of the reaction heat is supplied by the catalyst entering the reactor.

Simplified regenerator.—This is made possible by the higher catalyst-circulation rates. Since a major portion of the regeneration heat is absorbed by the flowing catalyst, 1 or 2 burning zones are sufficient; whereas, conventional T.C.C. units use 7 to 10.

Air for regeneration of the spent catalyst, supplied by a low-pressure blower, bypasses the air heater, which is used for startup only, and enters the kiln through a channel-type distributor.

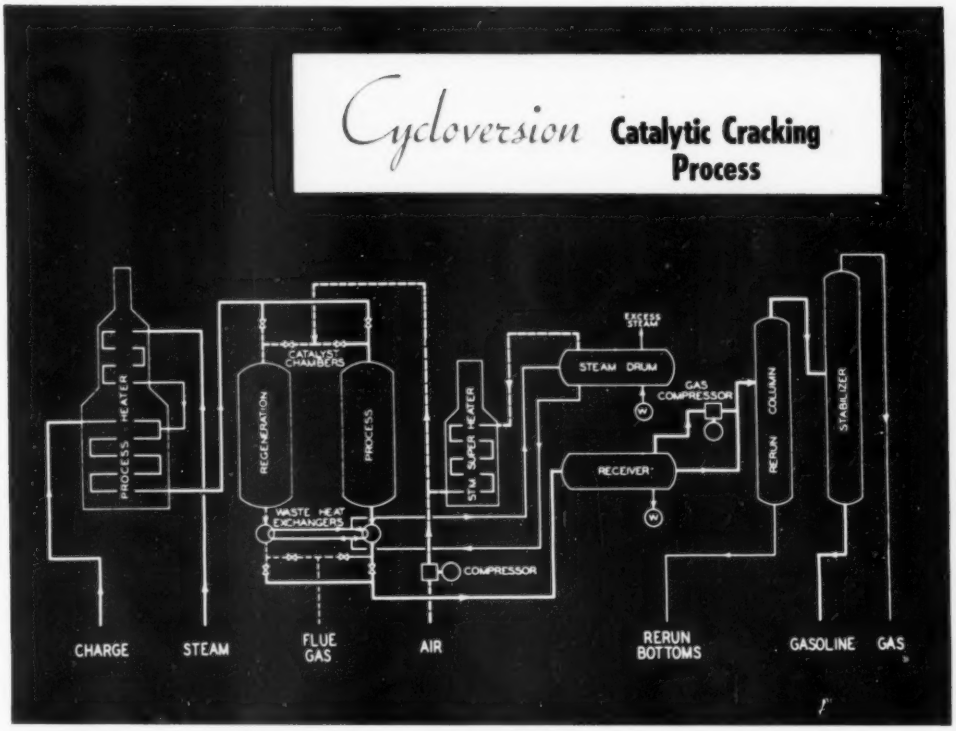
Pressure is maintained in the regenerator by means of a flue-gas control valve, which is positioned by a differential pressure recorder controller. A seal to prevent the escape of flue gas up the kiln seal leg is maintained by an automatically regulated flow of steam into the head of the regenerator.

Principal vessels.—A superimposed, self-supporting, circular reactor and regenerator section is the fourth distinguishing feature of Houdriflow. This arrangement of the principal vessels makes it necessary to lift the catalyst only once to complete a cycle of flow through the system, and results in a smaller ground area requirement for the installation of a unit of a given capacity.

Initial capital investment for a Houdriflow unit is approximately 80 per cent of that of a conventional T.C.C. unit of the same capacity. Additional economies also can be foreseen in that direct operating costs as well as maintenance costs are materially reduced. These advantages stem from the simplification in design. For example, a lower fuel requirement for reactor feed preparation accounts for a significant reduction in operating costs. Likewise, it is evident that the new kiln with a minimum of internal structural elements requires even less maintenance than a T.C.C. kiln.

Discussion on this process supplied by its licensor, Houdry Process Corp., Philadelphia.

Cycloversion Catalytic Cracking Process



THE Cycloversion catalytic cracking process is designed on a fixed-bed principle in which no appreciable loss of catalyst may occur through the formation of fines by abrasion. Equipment for the circulation, separation, and recovery of catalyst from the process or reactivation gases is not required. The natural bauxite catalyst employed in the process is capable of regeneration an indefinite number of times, and maintains 85 to 95 per cent of the cracking efficiency exhibited by new catalyst.

Operating Method

This process is characterized by simple, low-cost, flexible operation in the production of high-yield, superior-quality motor fuels. When catalytically cracking gas oil, the fresh or recycle feed is preheated to about 1,000° F. and then is admixed with a small quantity of steam diluent. This steam reduces carbon deposition on the catalyst, assists in vaporizing the charge stock, and improves the octane rating of the catalytic gasoline.

The superheated oil-steam mixture passes to the catalyst chamber at the desired operating pressure, usually in the range of 10 to 85 psig., where catalytic cracking is obtained in process cycles of 2 to 10-hour periods.

Reactor effluent, after waste-heat exchange for recovery of a large amount of the heat as steam production, passes to additional heat-exchange and condensing equipment.

Total chamber product passes through the oil-water-vapor separator for removal of condensed water, distribution of the vapors to the gas-recovery plant, and distribution of liquid-hydrocarbon condensate to fractionation.

Simultaneously with the processing of the gas-oil charge in the on-steam reactor, the alternate chamber is undergoing catalyst regeneration. Steam from the waste-heat exchangers is superheated to about 750° to 850° F., admixed with air, and charged to the chamber on regeneration. The regeneration gases are passed to waste-heat exchangers and finally vented to the atmosphere through a suitable vent stack.

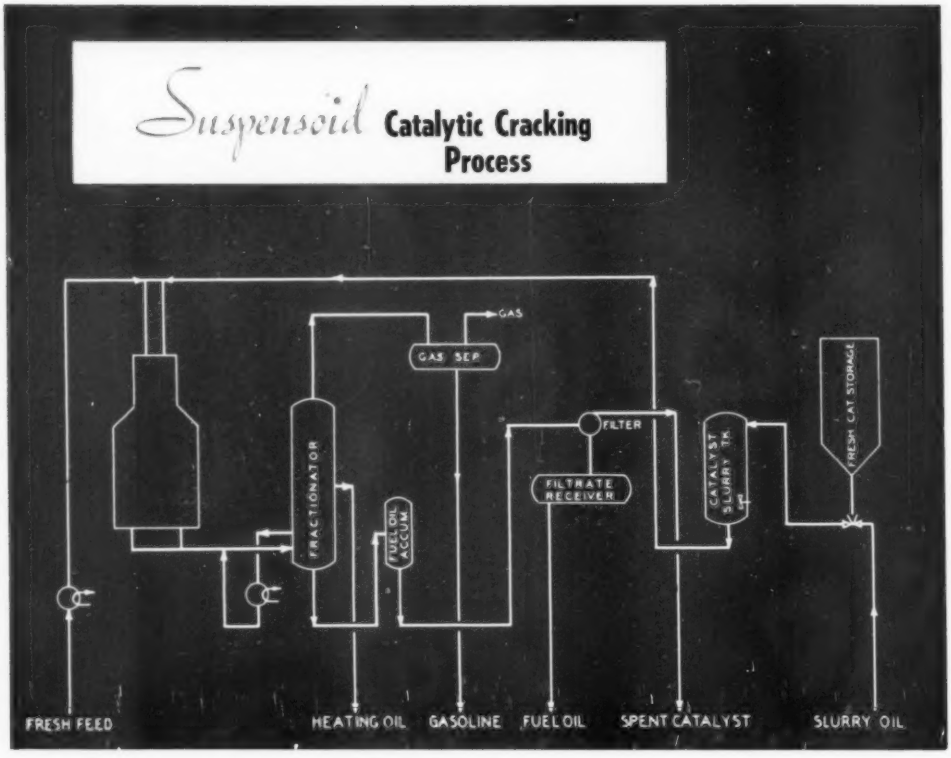
HIGH-PRESSURE (85 PSI.) CYCLOVERSION OF TEXAS PANHANDLE GAS OIL

Feed stock:		
Gravity, °A.P.I.		37.4
10 per cent		501
90 per cent		709
Aniline point, °F.		180
Catalytic gasoline, C_5-400° F.:	Test 1	Test 2
Gravity, °A.P.I.	56.3	55.4
Reid vapor pressure	6.4	4.8
A.S.T.M. octane number	76.7	77.7
3 cc. TEL	82.4	83.4
Research octane number	87.1	89.2
3 cc. TEL	93.4	94.8
Yields, per cent of charge:		
Catalytic gasoline, C_5-400° F., volume per cent	33.3	34.0
10-lb. R.v.p. gasoline, volume per cent*	40.9	44.2
Propylene, volume per cent	3.7	4.9
Butylenes, volume per cent	4.3	5.4
Catalytic recycle, 400° F., volume per cent	53.6	45.0
Carbon, weight per cent	1.5	2.6
Conversion, single pass, volume per cent	46.4	55.0

*Butanized and includes potential catalytic poly gasoline.

Discussion on this process was supplied by its licensor, Perco Division, Phillips Petroleum Co., Bartlesville, Okla.

Suspensoid Catalytic Cracking Process



THE Suspensoid catalytic cracking process differs from other processes for the catalytic conversion of hydrocarbons in that very small quantities of catalyst are used and a coil type of reactor, common to thermal cracking units, is employed. The process is also very flexible and a wide variety of feed stocks ranging from naphtha to heavy gas oils and cycle stocks may be processed in a single unit. In order to assist in vaporizing the heavy stocks at the temperatures and pressures required, a carrying agent such as naphtha, water, or light hydrocarbons may be added.

Finely divided catalyst is mixed with a portion of the charge to form a slurry. Between 2 to 10 lb. of natural or synthetic catalyst per barrel of total feed are customarily employed. The slurry is pumped to combine with the main body of the preheated charge just before entering the heater coils of the furnace. After heating the mixture to 1,030 -1,100 F., at pressures ranging from 150-800 psig. the charge is flashed into a combination tar separator and fractionating tower. A venturi-type orifice is located at the inlet to the flash tower to maintain the back pressure on the cracking system.

Catalyst-Heavy Oil Separation

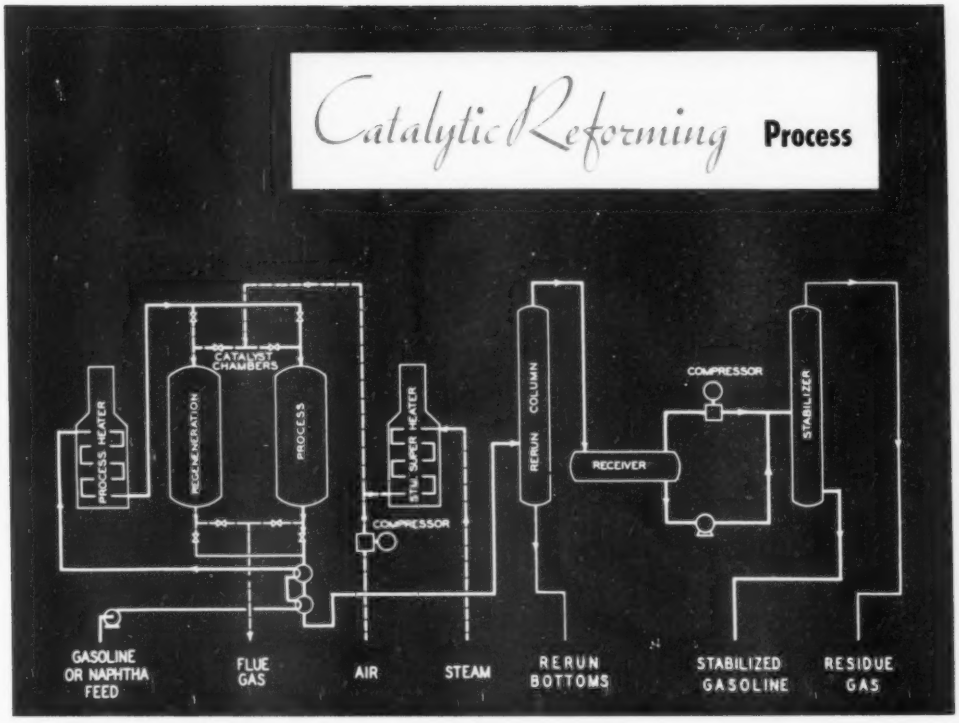
Gaseous and liquid products are fractionated in conventional manner and the fuel oil is sent to an accumulator from which it is pumped to precoat rotary-type filters which remove the catalyst from the heavy oil. Since conversions per pass are very high, once-through operations are customarily employed but, of course, insufficiently cracked oil from the bottom of the fractionator can be recycled. In the present units the catalyst is discarded after one pass operations. Conventional thermal cracking coils are generally satisfactory for suspensoid operations.

It is desirable to have low-chrome steel in the soaker section of the furnace and special streamlined return-bend headers to keep down erosion at that point under the most extreme conditions.

Development work on the Suspensoid process has been conducted both on refinery units and on a laboratory pilot unit which has been found to give essentially the same product yields and quality as obtained on the commercial plant units. It has been shown that any clean distillate feed stocks may be utilized, including the very heavy gas oils which, in view of the trend towards high withdrawals of middle distillates, may be expected to form a large proportion of the charge stocks for future cracking operations. Typical pilot-plant results for Suspensoid cracking 1,100° F. b.p. Mid-Continent Louden heavy gas oils blended with 15 per cent naphtha on total feed in the presence of added water are shown in the accompanying table.

Lb. 3A catalyst per bbl. feed	10	
Coil pressure, psig.	400	
Conversion to dry gas, Wt. per cent	18	22
Gasoline, 400° F. e.p. 10 lb. R.v.p., incl. non-selective polymer, LV per cent	57.0	58.5
Heating oil, 430 -600° V. T., LV per cent	10.8	9.3
Fuel oil, over 600° V. T., LV per cent	19.9	16.5
Gasoline (incl. polymer)—		
Res. oct. No. cl.	90.0	91.9
Res. oct. No. 2cc. TEL	94.9	96.2

Discussion on this process was supplied by its licensor, Imperial Oil Co., Ltd., Sarnia, Ont., Canada.



THE Cycloversion catalytic reforming process provides an economical means of both desulfurizing and catalytically reforming cracked and straightrun naphthas, gasolines, or blends. The normal benefits derived from Perco Cycloversion catalytic desulfurization are obtained along with an appreciable increase in clear octane rating. This is effected by some additional mild cracking or reforming as evidenced by the presence of fixed gases in the reactor effluent stream.

Normal operating conditions include chamber pressures from 50 to 100 psig., top-bed chamber temperatures of about 1,000° F., and process cycles of 24 hours or more. The feed is vaporized, and then is superheated prior to passing through the catalyst tower at the reaction temperature. Effluent vapors pass through the feed-product heat exchangers to the rerun and stabilizing towers from which the finished gasoline is sent to storage.

Only a small deposition of carbonaceous material occurs during normal process operation as compared to conventional catalytic cracking. This low carbon deposition on the catalyst permits an operation on relatively long process cycles and low-cost regeneration of the catalyst. The regeneration of the catalyst comprises burning off the carbonaceous material with a previously determined quantity of superheated air-stream mixture.

Fixed gas losses are relatively low and gasoline yields are high, particularly in view of the C_3 and C_4 components recoverable as poly feed.

It is significant that the process may be operated either at catalytic reforming or catalytic desulfurizing conditions and the unit operation is so flexible as to enable refiners to conduct a wide variety of operations on selected fractions or on total refinery gasoline, as may be desired or dictated by economics and finished-product sales. Likewise, the flexibility of unit operation will enable the refiner to meet product specifications with optimum tetraethyl lead costs, by varying conditions at any time to handle the preferred stock or stocks.

Typical Perco Cycloversion catalytic reforming results are given in the accompanying table. The appreciable increase in "jump" octanes, or the spread between A.S.T.M. and research values indicated in the table is of extreme interest to refiners having only thermal-type equipment. The process is not only applicable to stocks having moderately high total sulfur but also to those stocks having relatively low total sulfur contents.

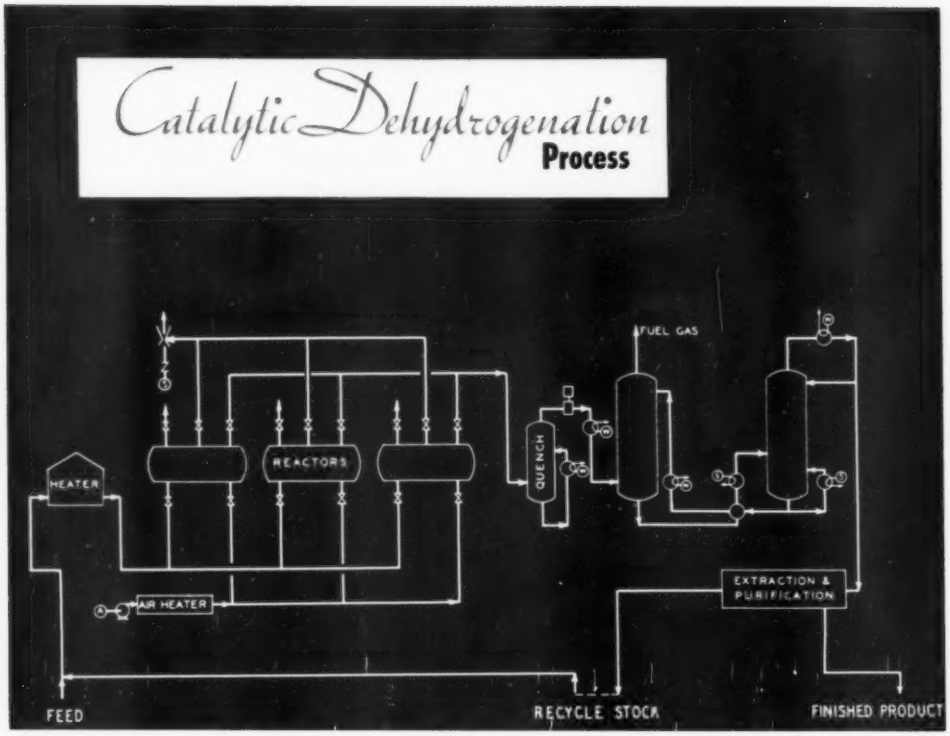
ILLINOIS STRAIGHTRUN GASOLINE
(64.4° A.P.I. gravity; 90 -360° F. boiling range)

	Raw feed	Cat. reformed*
A.S.T.M. octane number	54.1	61.3
1 cc. TEL	64.7	73.1
3 cc. TEL	73.0	81.8
Research octane number	52.7	63.8
1 cc. TEL	64.2	75.0
3 cc. TEL	74.2	83.4
R.v.p. at 100° F.	10.1	10.0
Total sulfur, per cent	0.022	0.008

*These catalytically reformed products are C_5 and heavier gasolines; the data do not contain potential poly gasoline from polymerization of C_3 and C_4 olefins produced.

Discussion on this process was supplied by its licensor, Perco Division, Phillips Petroleum Co., Bartlesville, Okla.

Catalytic Dehydrogenation Process



THE Houdry dehydrogenation process is equally applicable to the production of monoolefins and diolefins from their corresponding paraffins, diolefins from monoolefins, or from mixtures of paraffins and monoolefins and aromatics with unsaturated side chain from alkylaromatics.

Dehydrogenation is accomplished by passing over catalysts of suitable composition and controlled activity the preheated hydrocarbon vapors under regulated conditions of space velocity, temperature, and pressure. During the reaction period, a large amount of endothermic heat is absorbed. In addition to products of dehydrogenation, including free hydrogen, a small quantity of fixed gas is produced and coke is deposited on the catalyst. This coke has to be burned periodically to restore initial catalyst activity. Operating conditions are so chosen that the heat used for the reaction is substantially balanced by the heat developed from the combustion of the coke deposit.

Heat capacity of the catalyst bed is controlled by mixing with the active catalyst an inert material of granular form having high density and high specific heat. This inert material functions as a heat-storage medium, during the regeneration cycle absorbing the heat of combustion of the coke deposit with a resultant increase in temperature and releasing with corresponding temperature decrease this heat during the reaction period. A combination of short onstream periods and high heat capacity of the catalyst mass insures a narrow range of temperature necessary for optimum conversion and selectivity, while adjustments in the desired temperature levels are obtained by variation of hydrocarbon and air inlet temperatures.

The process utilizes the principles of the Houdry fixed-bed cracking process, with reactors operating in groups of three. The onstream period on each reactor is followed by a vacuum purge of hydrocarbons then a regeneration period carried out by circulation of air preheated by direct combustion of fuel in the stream. At the end of the regeneration period products of combustion also are purged by means of a steam ejector, prior to the following onstream period. Thus in a three-reactor group one reactor receives hydrocarbons while the second receives air and the third undergoes valve changes and purging operations. By these means, continuous flow of air and hydrocarbons is achieved.

Motor valves are operated by a cycle timer of conventional design and electrical interlocks preclude operation of a particular valve if the operation of the preceding valve has not been completed.

The products of reaction are cooled, separated from the fixed gases, and purified in equipment of conventional design, unconverted material being returned as cycle stock to the process.

Principal features of the process are:

1. Reactor construction requires no special-alloy heat-exchange equipment.

2. Reactants, introduced at substantially reaction temperature, exclude thermal cracking.

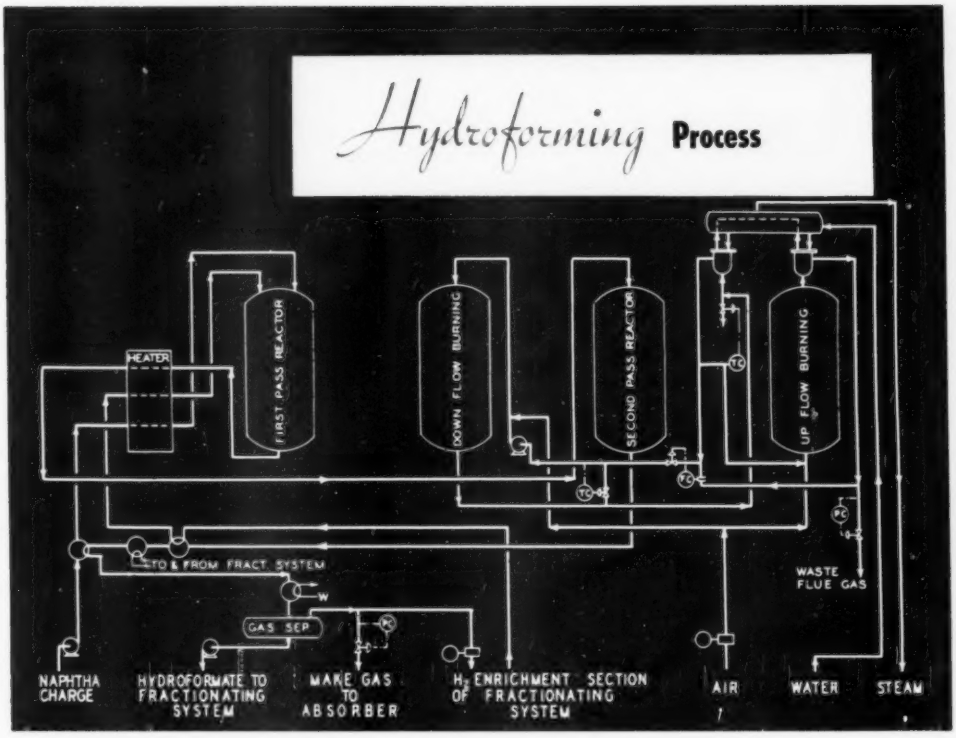
3. Extended catalyst life since no high temperatures are encountered during regeneration.

4. No flue-gas recirculation is necessary. Regeneration can be accomplished with fresh air.

5. Temperature control system allows maintenance of maximum conversion and selectivity.

Discussion on this process was supplied by its licensor, Houdry Process Corp., Philadelphia.

Hydroforming Process



THE Hydroforming process is primarily a catalytic operation for converting a low-octane naphtha into a high-octane gasoline. This conversion or reforming is accomplished largely by means of dehydrogenation and cyclization reactions. These reactions are promoted by a molybdena-on-alumina catalyst at 900°-1,000° F. and 150-300 psig., with a high partial pressure of hydrogen in the reaction zone. The hydrogen partial pressure is maintained by recycling hydrogen-rich gas to the reaction zone along with the vaporized fresh feed. The process usually produces a large amount of net hydrogen, which makes possible the hydrogen-rich recycle.

Naphthenes (cycloparaffins) in the feed stock are dehydrogenated and some molecules are slightly rearranged to form aromatics. Considerable cyclization of straight-chain hydrocarbons also takes place. If any olefins are present, as is the case when some cracked naphtha is included in the feed, these are almost completely converted to paraffins or ring compounds. Over 90 per cent of the sulfur contained in the naphtha is removed.

Yields of 78-80 volume per cent of 80 C.F.R.-M. octane, 100 per cent C_4 recovery gasoline are obtained, with the remainder of the material going approximately three-fourths to C_4-free gas and one-fourth to polymer and carbon. When operating to lower octane levels it is possible, by blending in extraneous butanes to the 10-lb. R.v.p. pressure level, to obtain a yield based on feed of 100 per cent of 60-octane gasoline which can be brought up to 80 C.F.R.-M. octane by the addition of 1.5 cc. of TEL.

Hydroforming is carried out in a unit usually having four or more reactors filled with catalyst, half of which are always in series on reaction, and the other half in different stages of regeneration. The reactors are switched from reaction through regeneration and back to reaction in cycles of 8 to 16 hours' duration by an electric cycle controller. Regeneration is necessary because a small deposit of carbon and a partial reduction of the metal in the catalyst combine over a period of hours to reduce the activity of the catalyst. The carbon is burned and the catalyst reoxidized by combustion.

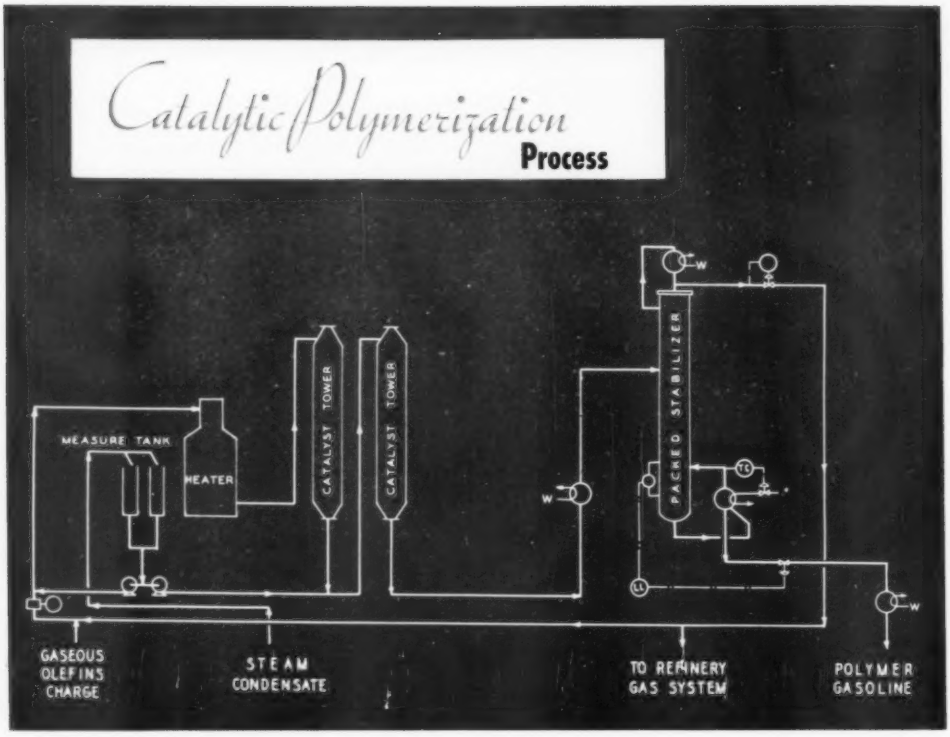
The reaction products are recovered and fractionated into: (1) a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, (2) a highly aromatic "polymer" boiling above 400° F., and (3) a depropanized, 400° F. end-point gasoline.

As a typical operation, naphtha is preheated in exchange with hydroformer charge transferring from reactor to cooler, and is introduced into the naphtha heater along with a light hydrocarbon gas-hydrogen mixture; the heated charge enters the reactor contacting the catalyst, a metallic oxide.

Flue gas and air mixed in the ration of four or five to one by volume, to dilute the oxygen content, is heated in a separate heater and forced via blower through the spent-catalyst beds.

Part of the hot gases from this regeneration is passed through a reactor in which the catalyst temperature immediately after regeneration is about 700° F. or lower, in order to bring the temperature up to about 950° F. Another portion of the hot gas is passed through a "waste heat boiler."

The process is licensed by H. W. Kellogg Co., New York, and Universal Oil Products Co., Chicago. Kellogg supplied this discussion and flow diagram.



THE development of the catalytic polymerization process offers to the petroleum refiner a means for converting a portion of fuel gas produced in cracking operations into a high-grade motor gasoline which increases the yield of gasoline obtainable from each barrel of crude oil processed. The process, in effect, then produces a finished gasoline of high value from a raw material which has the lowest value.

Polymerization of the butylenes in the absence of other olefins can be controlled to yield a product which on hydrogenation will rate 90-95 octane number. This is referred to as a selective polymerization operation used to produce aviation-gasoline components. Polymerization of propylene and butylenes in a mixture for the production of a fuel which will be blended in motor gasoline is referred to as a nonselective operation. This is the most common of all polymerization operations.

Propylene can also be polymerized separately to make either a motor polymer or a product rich in either C_6, C_9, or C_{12} polymer, depending on operating conditions.

Briefly, the polymerization operation is one which consists of contacting the olefin-containing feed stream with the catalyst at temperatures in the range of 350° to 475° F. and at pressures ranging from 150 to 1,200 psi. Processing conditions vary with the type of plant employed, with the feed stock processed and with the type of product desired.

There are two types of units now being used for carrying on the process of polymerization. The most commonly used design is known as a chamber type. In this unit the catalyst is contained in a vertical chamber. Catalyst is loaded in one or more chambers, each containing multiple catalyst beds of 5 to 10 ft. in depth.

Since the polymerization reaction is exothermic and the system in which the reaction takes place is essentially adiabatic, the temperature of the reactants increases as they travel through the catalyst beds.

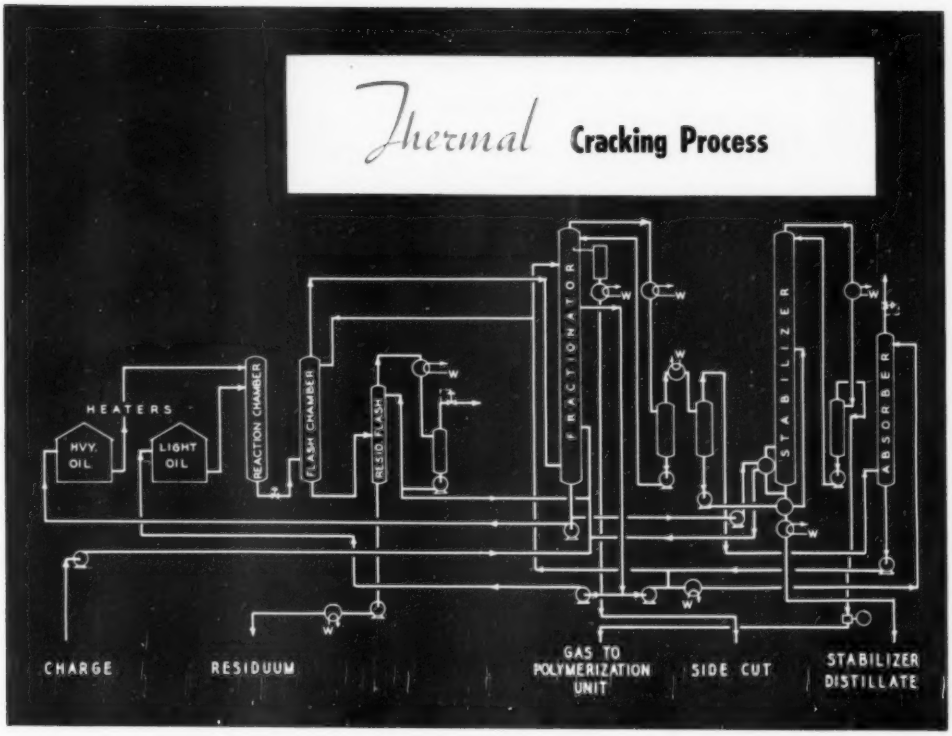
In order to maintain the catalyst temperatures in the range considered most effective for good olefin conversion and catalyst life, it is desirable to control the amount of reaction that occurs in the catalyst chamber by the recycling of hydrocarbons which have been through the catalyst chambers. This recycle material, being low in olefin content, will act to dilute the olefins in the fresh feed. It is possible in this manner effectively to limit the temperature rise through the reaction zone.

The reactor type of unit employs heat-exchanger-type reactors. In this design the catalyst is loaded in vertical small-diameter tubes which are surrounded with a cooling medium to remove heat of reaction.

Reaction temperature control is therefore obtained by controlling the temperature of the cooling medium, and in this manner the reaction approaches isothermal conditions. In this unit it is therefore possible to process feeds of high olefin content without the use of recycle as in the case of the chamber type unit.

Reactor type units are most commonly used when the feed to be processed is high in olefin content such as is the case for C_3 and C_4 fractions produced from catalytic cracking.

Discussion on this process was supplied by its licensor, Universal Oil Products Co., Chicago.



THE Thermal cracking process produces good gasoline from every variety of charging stock from naphthas to the heaviest crudes and residual oils. Thermal cracking also produces butylenes and propylene which can be polymerized to produce polymer gasoline of high octane number for use as a blending fluid to improve the quality of gasolines.

In the U.O.P. two-coil cracking unit the topped or reduced crude charge is introduced to the side of the fractionating column where it is contacted with vapors from the flash chamber. Overhead product from the fractionating column is gasoline.

Furnace or tractor distillates are withdrawn as sidecuts and stripped to specifications. From a lower sidecut tray a higher-boiling distillate comprising lower fractions of both recycle and charging stocks is withdrawn as charge to the light oil heater.

The charge to the heavy-oil heater is withdrawn from the bottom of the fractionating column, and consists of the highest-boiling fractions of both the recycle and charging stocks.

The mixture leaving the reaction chamber enters the flash chamber in which a fuel-oil residuum of the desired properties is separated.

With the U.O.P. Equiflux heater it is possible to obtain temperatures as high as 920° F. in the middle of the reaction chamber. With a reaction chamber operation at this temperature level the heavy charge is subjected to greater time-temperature action than can be achieved without the use of the reaction chamber as a means of viscosity breaking.

Cracking residual stocks at high-temperature levels results in cracked fuel oils of maximum stability and minimum sediment content. These properties are direct functions of the average temperature level of cracking, and in the modern two-coil unit the average temperature of the entire reaction chamber is greater than the maximum temperature ordinarily attained in coil-only viscosity breaking.

The single-coil thermal cracking unit is similar to the two-coil unit with the exception that recycle and fresh charge are cracked in one heater.

YIELDS FROM 25° A.P.I. MID-CONTINENT REDUCED CRUDE IN RESIDUUM OPERATION. VISCOSITY, 20 S.F.S. AT 122° F.

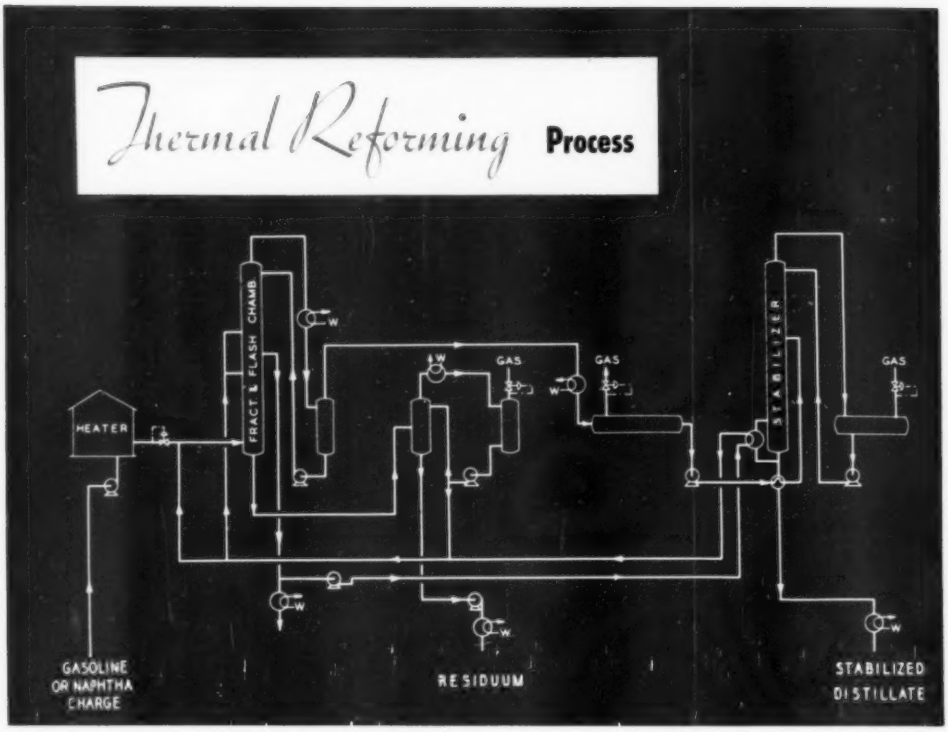
	Max. gasoline	Max. furnace oil
Per cent by volume of charge:		
Gasoline, 400 e.p., 10 R.v.p.	53.5	38
Furnace distillate		23
Fuel oil	37.5	34
Liquid volume loss	9	5
Gas, cu. ft./bbl.	500	290
Octane number (A.S.T.M.)	69-70	68-69
Fuel oil, vis., S.F.S. at 122° F.	200	200
Fuel oil, gravity, °A.P.I.	7	8
Per cent catalytic polymer gasoline, 10 R.v.p.	5	3.5
Per cent total gasoline, incl. polymer	58.5	41.5
Octane number of total gasoline	71-72	70-71

In considering these results, it must be remembered that not only the gravity but also the viscosity of the charge are important in determining yields.

It should be noted that the cracked-gasoline yields are all reported on the basis of 400° F. end point and 10 lb. R.v.p. On the basis of total butane-butylene retention in the gasoline the yields would be increased approximately 4 per cent and 3 per cent, respectively. The yields of catalytic polymer gasoline shown in the table are on the basis of polymerizing 80 per cent of the propylene and butylenes formed in the cracking operation.

Thermal cracking processes are licensed variously by Universal Oil Products Co., Chicago, M. W. Kellogg Co., New York, and other licensors. Universal Oil Products Co., supplied this discussion.

Thermal Reforming Process



THE thermal reforming process ranks with thermal cracking as one of the best known processes in the petroleum refining industry. This process converts low-grade gasolines and naphthas into high octane gasoline by subjecting the charging stock to heat treatment under controlled time, temperature, and pressure conditions. The process is flexible, not only in its ability to process various stocks, but also as to quality and quantity of products which can be made from these stocks.

Thermal reforming produces butane-butylenes and propane-propylene which can be polymerized to produce a high octane polymer gasoline which is an excellent blending material for improving the quality of other gasolines. The residuum produced by this operation has a high calorific value, and can be marketed as fuel oil.

Where polymerization of the gases evolved from the cracking operation is desired, an absorber for the receiver gases plus deep stabilization of the gasoline is employed to provide maximum recovery and utilization of polymerizable olefins available.

Results

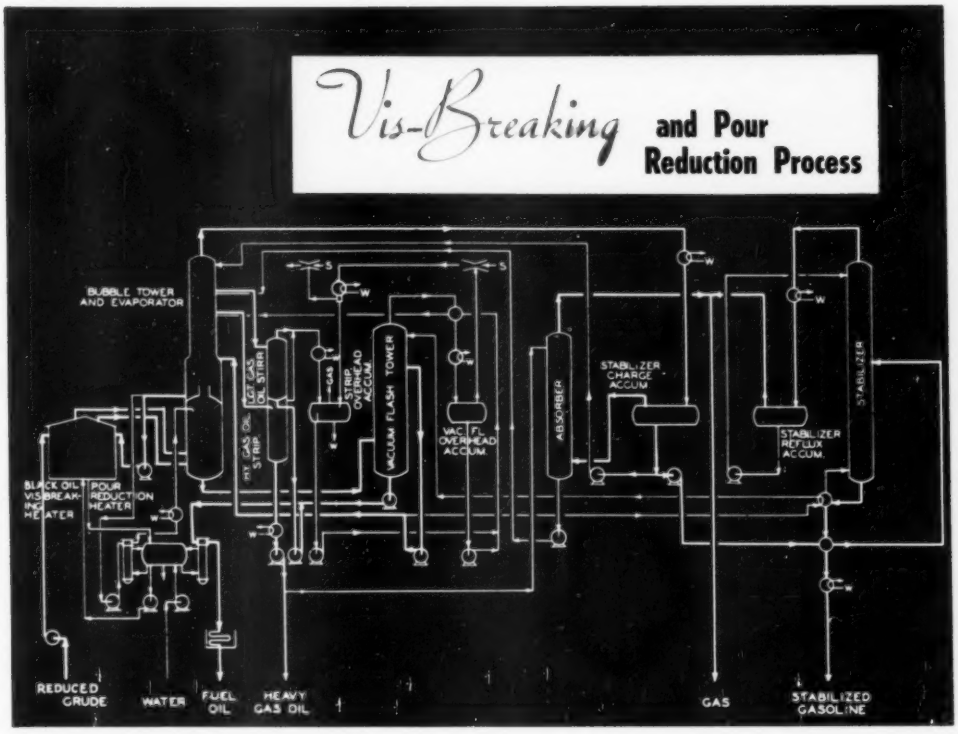
A typical result when reforming a 53° A.P.I. Mid-Continent straightrun naphtha is shown in the following tabulation. It must be realized in considering these results that the yields and octane rating improvement that can be derived from thermal reforming are dependent upon the characteristics of the charging stock. Each refining situation must be carefully analyzed and studied, not only from the standpoint of charging stocks available, but also from that of market requirements in order to design thermal reforming equipment properly.

THERMAL REFORMING OF MID-CONTINENT NAPHTHA

Charging stock:	
Gravity, °A.P.I.	53.0
Octane rating, A.S.T.M. (F-2) clear	40.5
Characterization factor	11.96
100-ml. distillation:	
I.b.p., °F.	208
10 per cent	263
50 per cent	314
90 per cent	367
E.p., °F.	389
Products:	
Gasoline:	
Yield, volume per cent of charge	81.3
Gravity, °A.P.I.	56.1
Reid vapor pressure, lb.	10.0
100-ml. distillation:	
I.b.p., °F.	93
10 per cent	145
50 per cent	270
90 per cent	360
E.p., °F.	398
Octane ratings:	
A.S.T.M. (F-2) clear	70.2
3 cc. TEL per gallon	81.9
Research (F-1), clear	78.2
3 cc. TEL per gallon	91.3
Residuum:	
Yield, volume per cent of charge	4.2
Gravity, °A.P.I.	18.2
Gas:	
Yield, weight per cent of charge	15.3
Cu. ft. per barrel of charge	467

Thermal reforming processes are licensed by Universal Oil Products Co., Chicago, M. W. Kellogg Co., New York, and others. Universal Oil Products Co. supplied this discussion.

Vis-Breaking and Pour Reduction Process



THE vis-breaking and pour reduction process operates on reduced crudes and residual oils to reduce fuel-oil yields and increase yields of gasoline and gas oils. Residual stocks may be visbroken by once-through, recycle, or two-stage operation. The selection of a particular scheme depends upon the characteristics of the charging stock, market conditions, product specifications required, economic considerations and the scope of the given refinery operations.

Two-Stage Operation

The Lummus viscosity-breaking process is designed to operate on high-pour, high-sulfur-content reduced crude to produce minimum yields of low-pour, low-viscosity fuel oil with maximum yields of low-pour cracked gas oil. This two-stage vis-breaking unit has a wide range of operating flexibility. One coil is used for once-through visbreaking of the reduced crude and the other coil for recycle cracking of the high-pour heavy gas oil produced in the first coil. Alternately, both coils can be employed in parallel for a recycle vis-breaking operation.

The vacuum flash incorporated in this process reduces the evaporator bottom to a heavy pitch which is cut back to low-viscosity fuel-oil specifications by blending with light cycle oil withdrawn from the bubble tower.

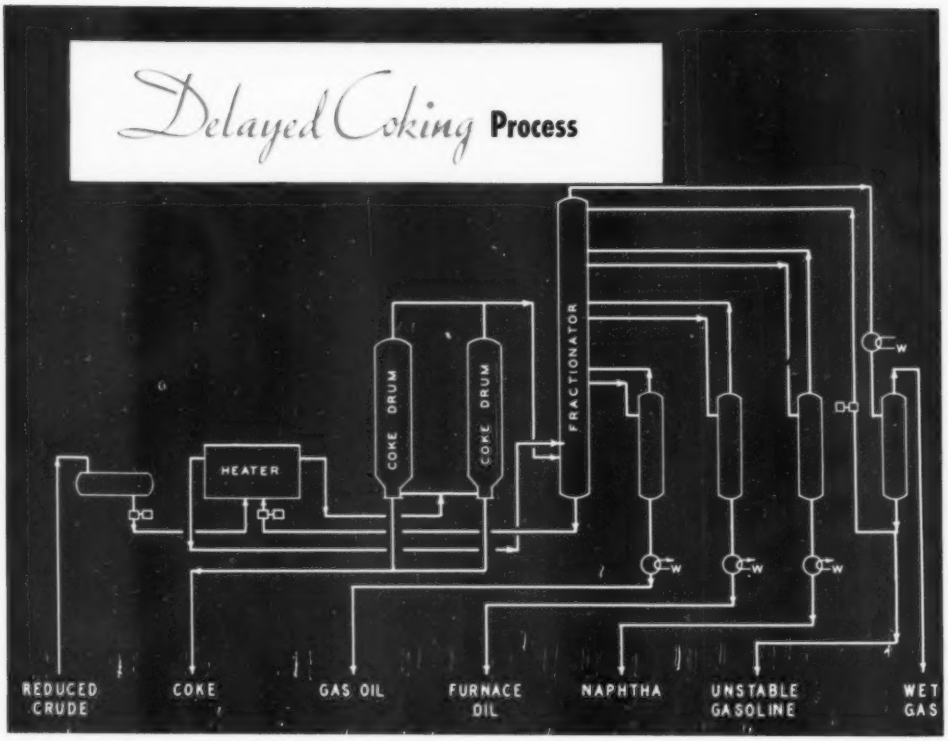
Light cycle blending oil is obtained from the bottom of the light gas-oil stripper which receives its charge via a side cut from the bubble tower. Heavy gas-oil stock is produced as bottoms from a second stripper. Feed to this stripper is also a bubble-tower side stream. Overhead from both strippers is combined with overhead from the vacuum flash column and fed back into the bubble tower. Any vapor coming from the vacuum flash tower not condensed in the tower's overhead cooling system is discharged via the evacuating system to additional condensing equipment. Condensate obtained in this final cooling is sent to the stripper overhead accumulator. Water and noncondensable gases are vented and drawn off at this point.

The high-pour-point waxy vacuum-tower sidestream is charged to the gas-oil cracking coil where its pour point is reduced by 40°-50° F. When heavy reduced crudes having gravities in the range of 12.0° to 16.0° A.P.I., viscosities from 300-800 S.S.F. at 122° F. and pour points from 70°-100° F. are charged to the unit, a finished fuel oil with a viscosity of 125 S.S.F. at 122° F. and a pour point of 20°-25° F. is produced. Aside from the relatively low yields of low-viscosity fuel oil and high yields of low-pour gas oils, this unit, in addition, produces approximately 20 per cent by volume of 10-lb. R.v.p. gasoline having an A.S.T.M. octane number of 70, when using naphthenic stocks.

Once-Through Operation

If the available residual charge stocks have a low pour point but a high viscosity, the production of low-viscosity fuel oil can be accomplished in a simple once-through operation. Such a unit costs approximately 70 per cent as much as the two-stage visbreaking and pour reduction unit discussed above.

Discussion on this process was supplied by Lummus Co., New York.



THE modern delayed coking process is operated on a continuous-throughput basis. Operation differs from that of the usual thermal cracking process in that the topped crude, which is heated rapidly, flows to the coking drum where it is coked by its contained heat. Depending on the type of feed stock and desired yields, the drum operates at pressures from 10 to 100 psig.

Feed stocks for catalytic cracking may be prepared in the process. Such stocks are shown to be of high quality and eminently suitable for this type of operation.

When processing a normal 30 to 40 per cent reduced crude, the charge is heated and flashed in the fractionator. The heavier bottom product is charged to the coker furnace coil in admixture with varying quantities of heavy gas oil obtained from the coking process proper. This mixture is heated to 900 to 975 and transferred to the coke drums.

Operating Conditions on Coke Drums

These coke drums are maintained at any desired pressure up to 100 psig. and at temperatures up to 900° F. While the light fractions vaporize and pass into the fractionator, the heavier oil is subjected to a long-time soaking period during which a decomposition of this heavier oil into lighter fractions and coke occurs.

Two or more drums may be used in sequence. When a drum is full of coke it is disconnected and replaced by an empty drum. Usually the removal of coke is effected by means of hydraulic decoking which cuts the coke from the drums through the use of high-pressure water jets.

The coke-drum vapors, except for the heaviest fractions which serve as recycle, are fractionated in the fractionator together with the flashed vapors from the fresh feed. An overhead product and various sidestreams of any desired specifications may be obtained. Frequently a full-boiling-range gas oil is withdrawn to be used as catalytic cracking feed stock.

Usually facilities to allow alternate operation as a vis-breaker are included.

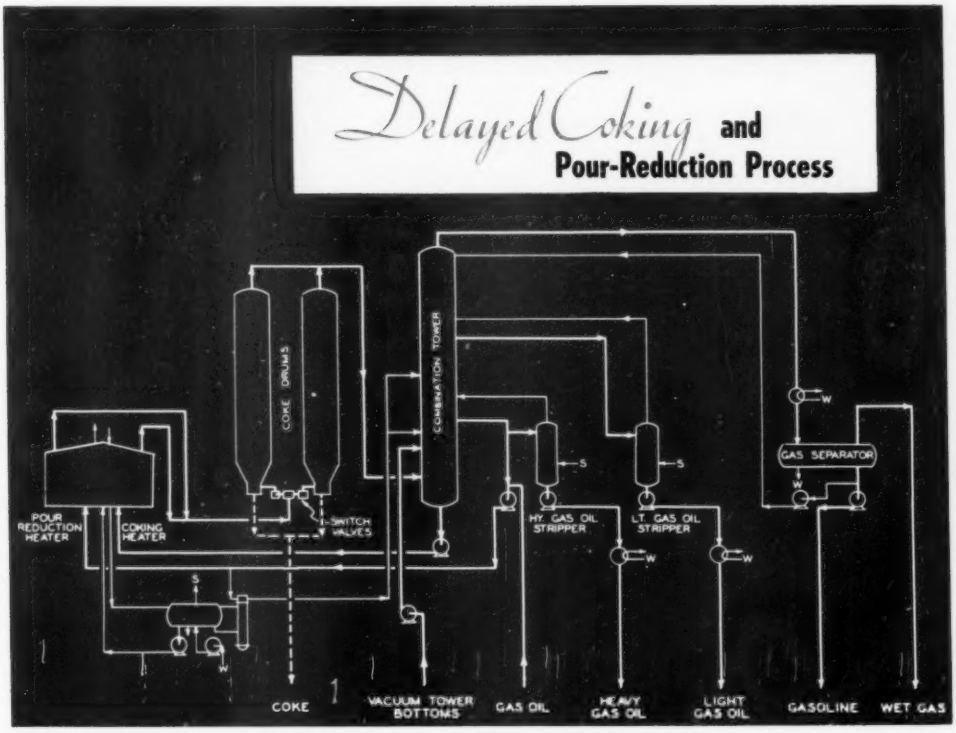
Products

The octane ratings of the motor-fuel fractions from coking operations vary with the characteristics of the feed stocks. Asphaltic, naphthenic, and similar charges will yield motor fuels with an octane (motor method) of 70-73. Paraffinic stocks will show gasoline of 60-64 octane or slightly higher.

TYPICAL YIELDS OF THE DELAYED COKING PROCESS

	Reduced crude:			
Feed stock—	Mid-Continent	East Texas	Producers (Calif.)	South American
Reduced crude on crude, %	30	30	93.5	63
Conradson carbon	6.0	8.0	6.2	11.4
Yields basis reduced crude:				
Gas, wt. %	4.0	4.7	4.8	6.9
Gasoline (400° e.p.-100% C_4), vol. %	19.0	21.0	12.2	20.6
Gas oil (875° e.p.), vol. %	74.0	70.0	76.5	63.4
Coke, wt. %	11.0	12.5	12.9	20.6

Discussion on this process was supplied by M. W. Kellogg Co., New York.



THE delayed coking process is employed to produce feed stocks for thermal or catalytic cracking operations from reduced crude oil and/or fuel oil. The coke yield is a function of the carbon residue of the charging stock. Gas oil (thermal or catalytic cracking stock) yields are high whereas gasoline yields are relatively small in delayed coking operations. A unit employing this process may be so designed as to be operable alternately for coking or visbreaking so that production of coke and specification fuel oil can be adjusted to meet market requirements.

Coke produced in the delayed coking operation has been found to be particularly desirable for the manufacture of electrodes. The general specifications of coke produced by this process are given in the accompanying table.

GENERAL SPECIFICATIONS—COKE

	Wt. per cent
Moisture	Nil- 0.5
Volatile matter	8.0-12.0
Ash	0.2- 1.3
Sulfur	0.5- 3.5
Soluble	Nil- 1.0
Total silica and iron oxide	Nil- 0.5

Delayed Coking and Pour Reduction

Where there is a demand for low-pour-point gas oil to be marketed without further processing, a combination of coking with gas-oil pour reduction may be employed. In this operation the gas oil is cracked in a separate coil at more severe conditions than are employed in the coking coil. As a result, the pour point of the gas oil produced is reduced by approximately 30°-50° F. with a decrease in the net yields of gas oil and an increase in the amount of gasoline and coke produced (all as compared with the process alone). The addition of a pour-reduction coil to a coking unit provides thermal cracking capacity at a low incremental cost and gives the refinery operation the desirable flexibility which enables it to meet variations in market requirements.

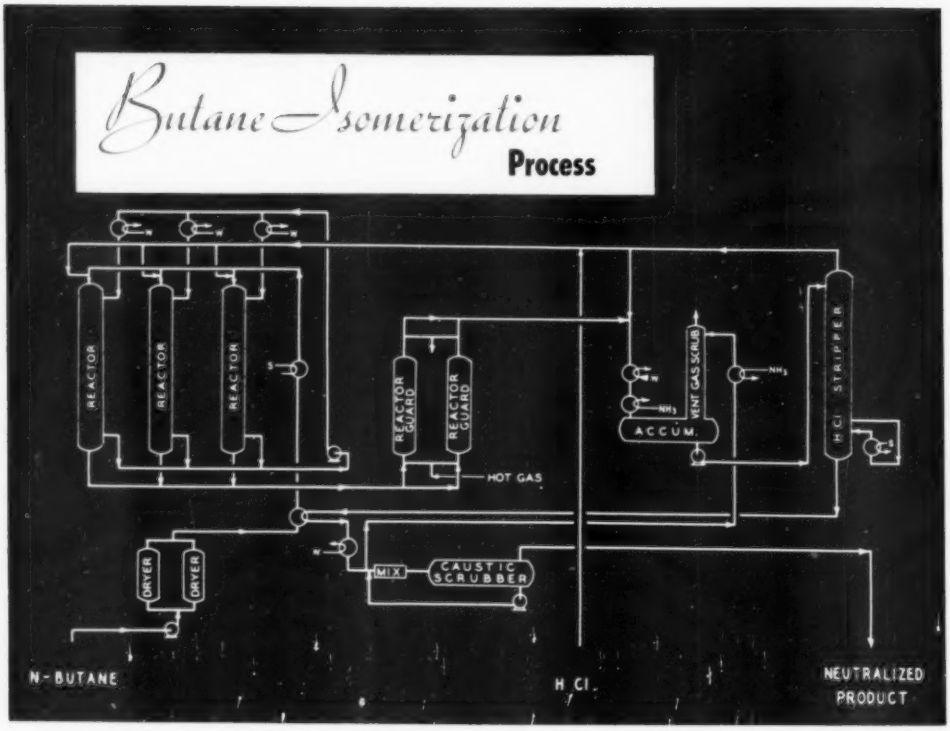
Gas-oil feed to the process enters the pour-reduction coil of the heater along with a portion of the heavy gas-oil side cut from the combination tower. This coil along with the coking coil discharges via "switch valves" to the coking drum. Vacuum-tower bottoms are fed into the combination tower with overhead from the coking drum and a portion of the stream going to the pour reduction coil.

Both side streams from the combination tower, light and heavy gas oil, are stripped. Make from the combination-tower overhead is gasoline. Wet gas is separated from the gasoline for further processing as desired. Products from the operation are coke, heavy gas oil, light gas oil, and gasoline.

In cases where the temperature entering the coke drum is limited to about 900° F., the transfer-line temperature of the coking heater can be reduced to as low as 820° F., depending on the ratio of gas oil to reduced crude furnace-charge rates. In an operation of this type, the coking heater operates as a preheater and does not limit the length of the run.

Discussion on this process was supplied by Lummus Co., New York.

Butane Isomerization Process



BUTANE isomerization by the Shell process employs a catalyst in conversion of normal butane to isobutane. The reaction is carried out in the vapor phase in reactors containing granular aluminum chloride catalyst. A reactor for this process may have a single catalyst bed, or it may be of the heat-exchanger type. In the latter case, the catalyst is placed in tubes surrounded by circulating cooling liquid. Through one or more of these reactors is passed a mixture of normal butane and anhydrous hydrogen chloride, the latter acting as a catalyst promoter. As the isomerization reaction is reversible, the feed should contain as little isobutane as possible.

Process Flow

After a single pass through the reactors, the stream flows through an absorber where volatilized aluminum chloride is removed. From here it goes through a cooler and a refrigerated condenser which liquefies all the butanes, the hydrogen chloride going into solution. The small amount of gas that cannot be condensed is vented through an absorber where hydrogen chloride is recovered by scrubbing with product recycle. The condensate is then stripped of HCl.

In a typical isomerization plant the normal butane feed passes from the charging pump through a drier in which all traces of moisture are extracted. The circulating solution of strong, aqueous caustic soda commonly used for dehydration has the additional advantage of being able to remove harmful acidic components which may remain in the stream from prior processing. The feed is vaporized, divided, and run to the multiple reactor system, each stream receiving a controlled quantity of hydrogen chloride recycle gas.

After passing through the catalyst beds, the streams are combined and conducted through guard chambers filled with alumina which effects adsorption of the small quantity of $AlCl_3$ volatilized from the catalyst. The isomerizate then flows through a cooler and condenser into an accumulator, or receiver. Liquid from the receiver is pumped to the top of a hydrogen chloride stripping column from which HCl is removed as the top product and recycled to the feed stream. The bottom product, consisting of butanes that are substantially free from HCl, is scrubbed with caustic to remove residual traces of hydrogen chloride and aluminum chloride.

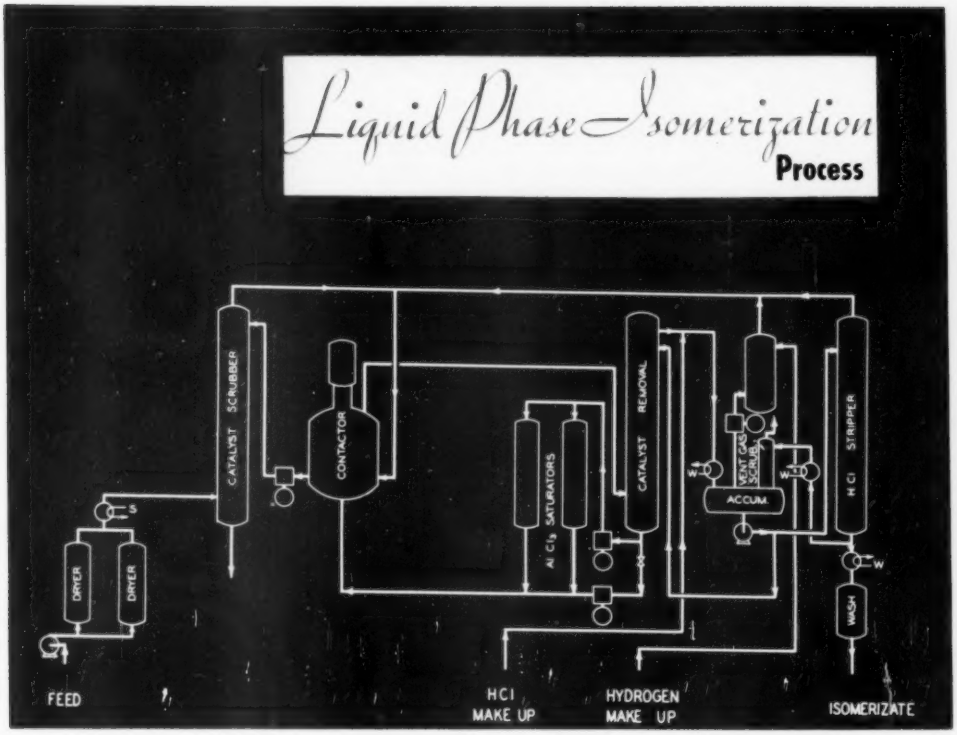
Catalyst

The catalyst was specially developed for the process and consists essentially of granular alumina impregnated with anhydrous aluminum chloride. It is rugged, cheaply produced, and long lived; these factors make it possible to discharge spent catalyst instead of regenerating it. Although it is resistant to poisons, it is necessary to remove most of the olefins and pentanes in the feed, as they destroy catalyst activity by forming tarry byproducts.

No special construction materials are required for the plant as dry hydrogen chloride is not corrosive under the conditions generally prevailing in the process. In existing units, all major equipment is constructed of steel, with alloys used only in special applications such as trim on pumps and valves.

Discussion of this process was supplied by its licensor, Shell Development Co., New York.

Liquid Phase Isomerization Process



EITHER butane or pentane may be isomerized by the Shell liquid-phase process, which is entirely continuous and regenerative. The process is one in which normal butane or normal pentane is contacted in the liquid state with a catalyst consisting of aluminum chloride dissolved in molten antimony trichloride.

The feed hydrocarbon is mixed with dry hydrogen chloride gas which acts as a catalyst promoter. In addition, when pentane is isomerized by this process, it is necessary to introduce a disproportionation suppressor such as hydrogen along with the HCl as disproportionation reactions, if not controlled, would result in a low ultimate yield of isopentane and high catalyst consumption.

Converts Butane or Pentane

Either butane or pentane may be converted to the corresponding isoparaffin in the same plant; the only additional pieces of equipment required for the C_5 hydrocarbon are the hydrogen compressor and its surge. The compressor can be eliminated, however, if a source of hydrogen at the desired pressure is available so that it can be used on a once-through basis.

In operation, the normal paraffin is charged continuously, at approximately atmospheric temperature, to one of two driers. Temperature of the dried feed is raised to about 180° F., before entering a packed catalyst scrubber column. Here a small sidestream of catalyst from the contractor is countercurrently extracted with the feed. The valuable active catalyst components are returned to the contactor in solution. The essentially inactive $AlCl_3$-hydrocarbon complex, formed as a result of side reactions, settles to the bottom of the column and is periodically drawn off.

Process Flow

The feed stream, containing recovered aluminum chloride and antimony trichloride, flows from the top of the catalyst scrubber column and is joined with recycle hydrogen chloride and, in the case of pentane isomerization, recycle hydrogen prior to entrance into the reaction vessel.

The converted hydrocarbon stream flows from the contactor to the catalyst column for separation and recycle of the dissolved catalyst components. The small amount of noncondensable gas formed in the process is vented from the vapor space of the accumulator through a packed absorber. The HCl content of the vent gas is reduced to a minimum by a countercurrent wash with a cooled sidestream taken from the bottom product of the HCl stripper.

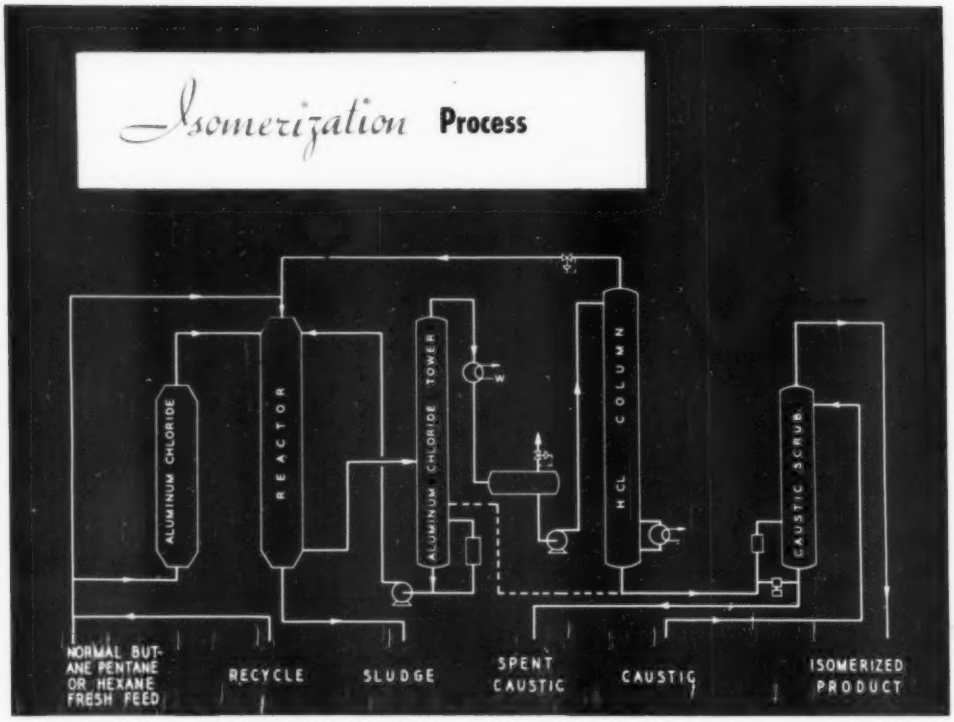
In pentane isomerization, most of the hydrogen is recycled from the vapor space in the accumulator; however, some remains in solution and passes to the HCl stripper from which it is recycled with the HCl.

HCl Stripper

From the catalyst column accumulator the isomerizate is pumped to the HCl stripper. The acid gas is removed from the top of the stripper and recycled to the contactor. The bottoms product stream is cooled and washed with dilute caustic to remove final traces of hydrogen chloride and antimony trichloride, and the neutralized isomerizate then passes to storage or subsequent operations.

Discussion on this process was supplied by its licensor, Shell Development Co., New York.

Isomerization Process



THE Isomerization process has been used extensively for the isomerization of normal butane to isobutane which is one of the raw materials for making high-octane gasoline blending component known as alkylate. The process is also applicable for the isomerization of normal pentane and hexane for improvement of the octane number of these fractions.

The process involves the contacting of a dry feed with a catalyst which contains aluminum chloride and hydrogen chloride. Anhydrous hydrogen chloride is used as a promoter for the reaction and is recycled within the system to maintain the required concentration in the reaction zone.

The liquid hydrocarbon and chemicals composing the combined feed are contacted in their passage through the reaction zone. In the isomerization reaction a minor secondary reaction takes place, namely, the formation of a viscous liquid sludge containing dissolved aluminum chloride and hydrogen chloride which spreads over the packing surfaces. The sludge thus formed continuously drains from the packing and separates from the butane stream below the catalyst zone in the bottom section of the reactor and this small amount of material is drawn off intermittently to a neutralizing pit. The hydrocarbon effluent from the reaction zone, containing dissolved aluminum chloride and hydrogen chloride, then enters the aluminum chloride and hydrogen chloride recovery section.

The isomerization reaction is slightly exothermic. The heat generated in the process is absorbed by the vaporization of some of the liquid passing through the reactor, and as a result the reaction is essentially isothermal. The process is operated at pressures in the order of 250-350 psi. and temperatures of 190° to 220° F.

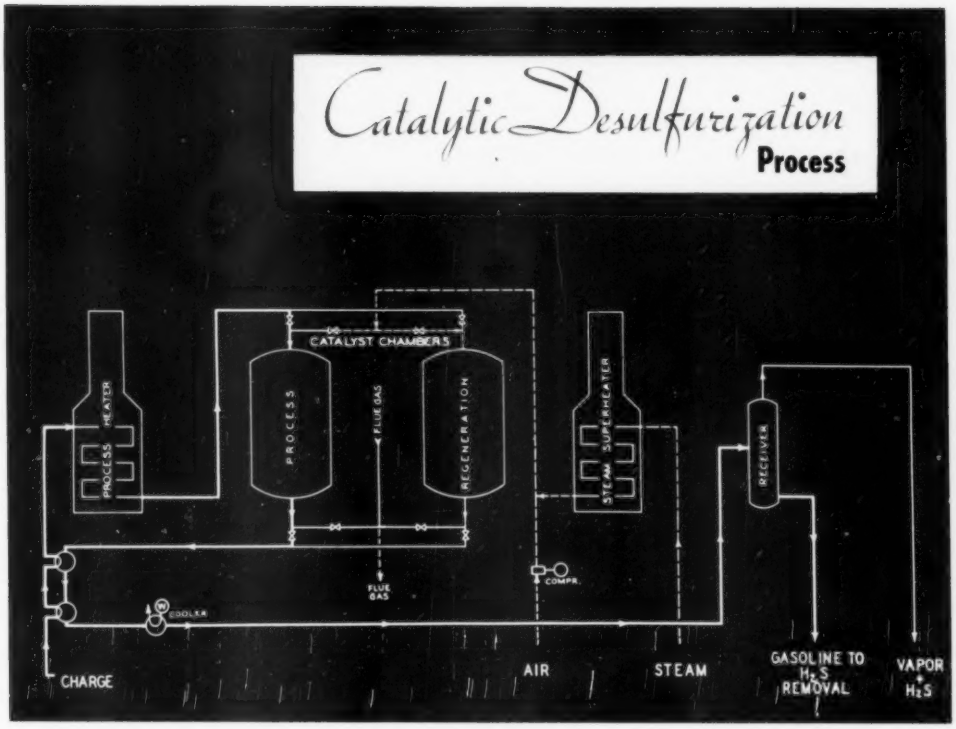
The isomerization of pentanes or hexanes is carried out in substantially the same manner as that for the processing of normal butane with the exception that in the processing of these heavier materials there is a greater tendency for the formation of sludge, and this must be counteracted by the injection of an inhibitor which serves to suppress secondary sludge-forming reactions.

TYPICAL ISOMERIZATION RESULTS—NORMAL BUTANE, PENTANE, AND HEXANE FEEDS

Type of feed—	n-Butane	n-Pentane	Hexane fraction
Operating conditions:			
Reactor temperature, °F.	190	180	180
Reactor pressure, psi.	250	250	250
HCl in reactor feed, mol per cent	7-10	7-10	7-10
Product analyses:			
Isobutane	50		
Normal butane	48		
Isopentane		60	
Normal pentane	2	38	
Hexane and heavier		2	
Octane ratings:			
Feed A.S.T.M. octane number, clear			58-60
Product A.S.T.M. octane number, clear			75-80
3 cc. TEL per gal.			88-93
Catalyst consumption:			
Lb. $AlCl_3$ per bbl. iC_4 or iC_5 produced	0.3-0.5	0.5-0.7	
Lb. HCl per bbl. iC_4 or iC_5 produced	0.05	0.05	

Discussion on this process was supplied by its licensor, Universal Oil Products Co., Chicago.

Catalytic Desulfurization Process



THE Cycloversion catalytic desulfurization process removes, in general, 40 to 60 per cent of the sulfur content of cracked gasolines, 60 to 98 per cent from straightrun gasolines, and 90 to 100 per cent from natural gasoline. The types of sulfur compounds removed by the process include mercaptans, sulfides, and disulfides—the cyclic compounds are not greatly affected. The variation in quantity of cyclic compounds present in the above-mentioned types of gasoline accounts for the differences in reduction of total sulfur content.

Operating Method

Basically, operations of this process result not only in "desulfurization" but also in a "catalytic" effect, producing improvement in octane and in TEL response not otherwise obtained merely by conventional methods for sulfur removal.

Operating cycles up to 30 days or more for a charge of catalyst are obtained on many gasolines. Catalyst cost is in the order of 1 per cent per barrel of gasoline treated.

The treatment of cracked gasolines or blends containing cracked gasolines tends to deactivate the catalyst. Auxiliary equipment is provided for catalyst regeneration, which is accomplished by charging to the alternate chamber a stream of low-pressure air to burn off the carbonaceous matters. The air is admixed with a predetermined quantity of steam superheated to give a temperature of approximately 750° F. for the air-steam mixture entering the reactor on regeneration.

The catalyst employed in the process can be regenerated an indefinite number of times without appreciable impairment of its activity. There is substantially no loss of hydrocarbons involved in the desulfurization treatment.

Typical examples of the effects of catalytic desulfurization on lead response are shown in the accompanying tables.

CRACKED GASOLINE

56° A.P.I. gravity; 9-lb. R.v.p.; 420° F. e.p.

	Undesulfurized	Desulfurized
A.S.T.M. octane number	65.7	69.1
1 cc. TEL	70.0	75.8
2 cc. TEL	72.4	78.0
3 cc. TEL	74.5	79.8
Total sulfur, per cent	0.140	0.076
Mercaptan sulfur, per cent	0.062	0.003

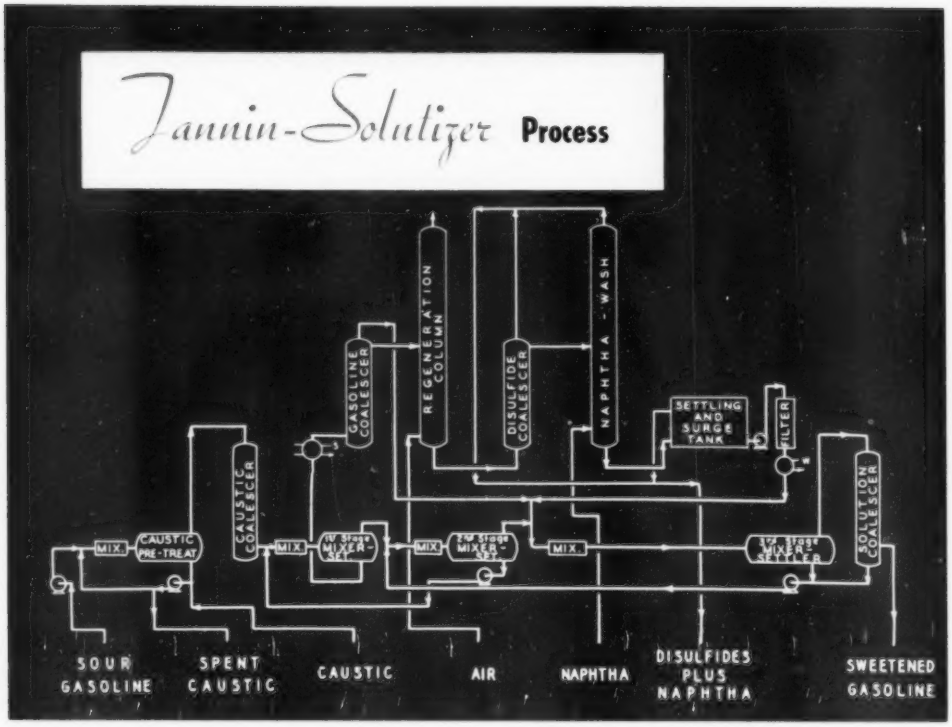
CRACKED-STRAIGHTRUN-POLY GASOLINE

66.2° A.P.I. gravity; 9.9 R.v.p.; 355° F. e.p.

	Undesulfurized	Desulfurized
A.S.T.M. octane number	58.6	63.9
1 cc. TEL	66.4	73.9
3 cc. TEL	73.1	79.0
Research octane number	61.4	67.2
1 cc. TEL	70.0	76.6
3 cc. TEL	77.9	83.7
Total sulfur, per cent	0.088	0.024
Mercaptan sulfur, per cent	0.023	Sweet

Discussion on this process was supplied by its licensor, Perco Division, Phillips Petroleum Co., Bartlesville, Okla.

Tannin-Solutizer Process



REMOVAL of mercaptans from sour gasoline by the tannin-solutizer process is carried out in two steps—extraction and regeneration. In the extraction step the sour gasoline is brought into intimate contact with strong caustic solution containing, besides a small amount of tannin, mercaptan-solubility promoters (solutizers) such as fatty acids, e.g., propionic and butyric acids, and/or alkyl phenols. In the regeneration step tannin serves to catalyze the oxidation of the extracted mercaptans to disulfides. These are removed from the solutizer solution prior to recycle to the extraction operation.

Processing Arrangement

The three essential sections of the process are caustic pretreat, solutizer treatment, and regeneration system. Caustic pretreatment is often necessary to remove strongly acidic components, such as hydrogen sulfide, an in some cases to control the alkyl phenol concentration. A single conventional mixer-settler arrangement is usually satisfactory for this purpose, and the caustic solution may be used until it is essentially saturated. A coalescer follows the caustic settler to minimize contamination of the potassium hydroxide treating solution with sodium ion.

In the extraction system the sour hydrocarbon feed is contacted with a suitable solutizer solution in countercurrent flow. The solution may contain as solutizer either added fatty acids or naturally occurring alkyl phenols. The latter may be used if their concentration in the fraction treated is great enough to maintain the required solutizer strength in the treating solution. For this purpose only a nominal concentration of alkyl phenols in the gasoline is needed; consequently most plants are self-sufficient and have very low solution costs. A typical system may use mixer-settler stages; however, other suitable contacting equipment, such as towers having either Raschig ring packing or perforated tray design, may be used. The sweetened hydrocarbon flows from the extraction system to storage or subsequent operations.

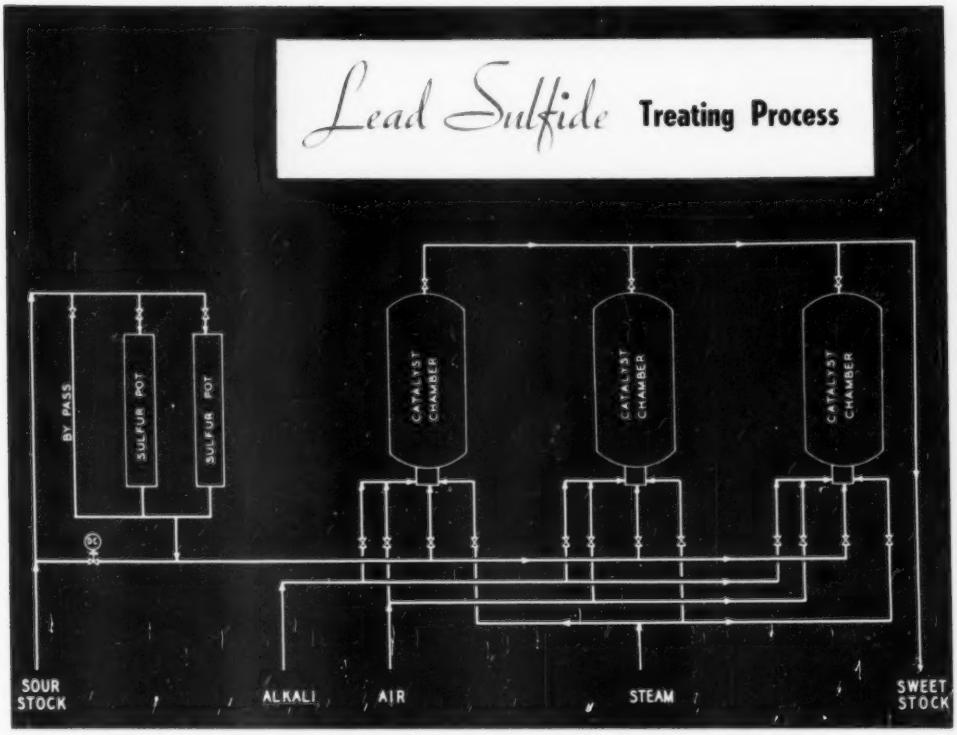
By this process, mercaptan removal to the "odor sweet" level of 0.001 to 0.003 weight-per cent mercaptan sulfur is easily achieved when treating a wide range of straightrun or cracked stocks, either low-end-point or full-boiling-range gasolines, having a naphthenic or paraffinic crude source. In many cases mercaptan content may be reduced to the doctor-negative specification by means of more stringent operating conditions and an increased number of extraction stages.

Features

A simple and flexible design, quite readily adaptable to utilization of existing equipment, characterizes this process. No corrosion-resistant metals are required as operating temperatures are low and the treating solution is noncorrosive. Labor costs are low due to simplicity of operation and adaptability to virtually complete automatic control. The solution is inexpensive and has an indefinite treating life, so that chemical cost is nominal. Exhaust steam can be used to fulfill the limited heating requirements.

This process is licensed by Shell Development Co. under its patent and those of Socony-Vacuum Oil Co., Inc. Discussion supplied by Shell Development Co., New York.

Lead Sulfide Treating Process



THE lead sulfide treating process employs sulfur as the reactant in sweetening sour stocks with lead sulfide (PbS) as the agent. Involving sulfur instead of oxygen in the reaction, hydrogen sulfide rather than water is found.

The main reaction in the process is:

$$4RSM + S_2 \xrightarrow{PbS\ (cat.)} R_2S_2 + H_2S$$

Mercaptan — Disulfide — Hydrogen sulfide

Caustic soda added to the mixture to react with the sulfide permits continuance of the reaction. Admission of oxygen must be held to a minimum, it is claimed. Oxygen damages the PbS catalyst, converting it probably during the sweetening process to $PbSO_4$, lead sulfate, which is converted to the sulfide again only with great difficulty and has very little sweetening reactivity. The principal (sulfur) reaction is also interfered with by the presence of oxygen.

Catalyst Preparation

Problems in adapting this reaction to refinery sweetening operations are likely those of catalyst preparation and control of the sulfur and alkali solutions. Catalyst is prepared by coating carrier-pellet surfaces with a lead compound which is converted to the sulfide after the catalyst material is in place, ready for use. Pellet size and catalyst-bed proportions are important in obtaining the optimum results in treating any stock.

Raw stock entering the system is divided into two streams, part of which passes through sulfur pots where it picks up sufficient sulfur to carry out the primary reaction. The remainder of the stock flows to the catalyst towers where it mingles with the caustic, air, and/or steam injected into the tower base. Air or steam aids in mixing caustic and charge stock.

The solution and charge enter at the bottom and travel up the catalyst chambers. Sulfur content of the reaction mixture is controlled by the amount of charge sent through the pots, to a predetermined range of concentration.

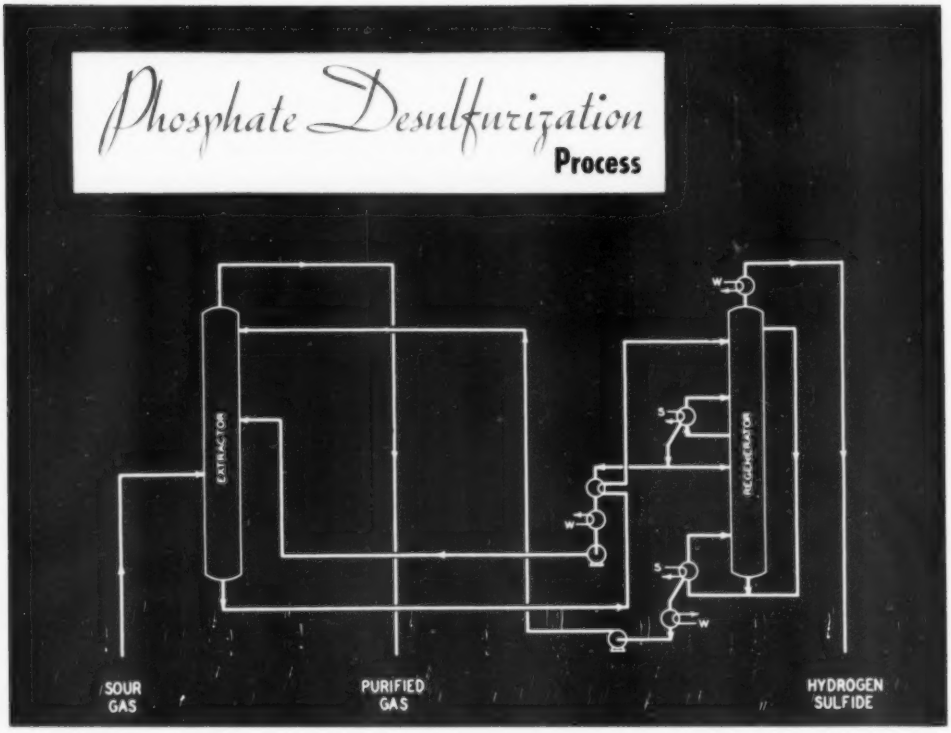
The reaction proceeds best, and with little operator attention after the concentrations are determined, by removing a maximum amount of the introduced caustic with live steam; air is not used until the normal action of the catalyst bed has decreased due to physical causes and should then be used sparingly since the tendency to convert the sulfide to sulfate is strong.

Kerosine Treating

In kerosine-treating service the process has proved particularly efficient. Over a period of approximately 10 years' operation more than 1 million barrels of kerosine have been processed by one installation. The kerosine processed in this unit averages about 0.08 per cent total sulfur. Maximum mercaptan content of the kerosine, sufficient to give it an objectionable odor, is 14 mg. per 100 cc. Treatment of this kerosine by the lead sulfide process produces a marketable product economically.

This process was developed by Sinclair Refining Co. technologists.

Phosphate Desulfurization Process



THE Shell phosphate process for removal and recovery of hydrogen sulfide from natural and refinery gases and liquid hydrocarbon fractions is a continuous regenerative-liquid purification system. The treatment comprises two steps: absorption and regeneration.

The principal absorption reaction may be expressed:

$$K_3PO_4 + H_2S = K_2HPO_4 + KHS$$

Regeneration of the solution is accomplished by use of stripping steam, and reverses the absorption reaction. Treatment of both the gas and liquid phases differs only in extractor design, and in the use of split solution for extraction of H_2S from the gas phase in cases where separation is difficult.

The tripotassium phosphate solution employed in the process selectively removes H_2S in the presence of CO_2. Since CO_2 in liquid hydrocarbon streams is at most a small percentage of the H_2S present, discussion of this factor applies only to vapor-phase operation. This preferential absorption of H_2S in the presence of CO_2 is highly advantageous in desulfurization of natural, synthesis, or other similar gases in which the salable quantity of gas may be increased over that resulting from desulfurization by those commercial processes which also effect removal of virtually all of the CO_2.

The phosphate process is particularly suitable for fume elimination involving H_2S recovery and conversion to sulfur. An important consideration in such cases is the recovery of the H_2S in high purity, i.e., having minimum CO_2 and hydrocarbon content. Gases containing CO_2 and H_2S in ratios as high as 10-20 to 1 may be treated economically for H_2S removal.

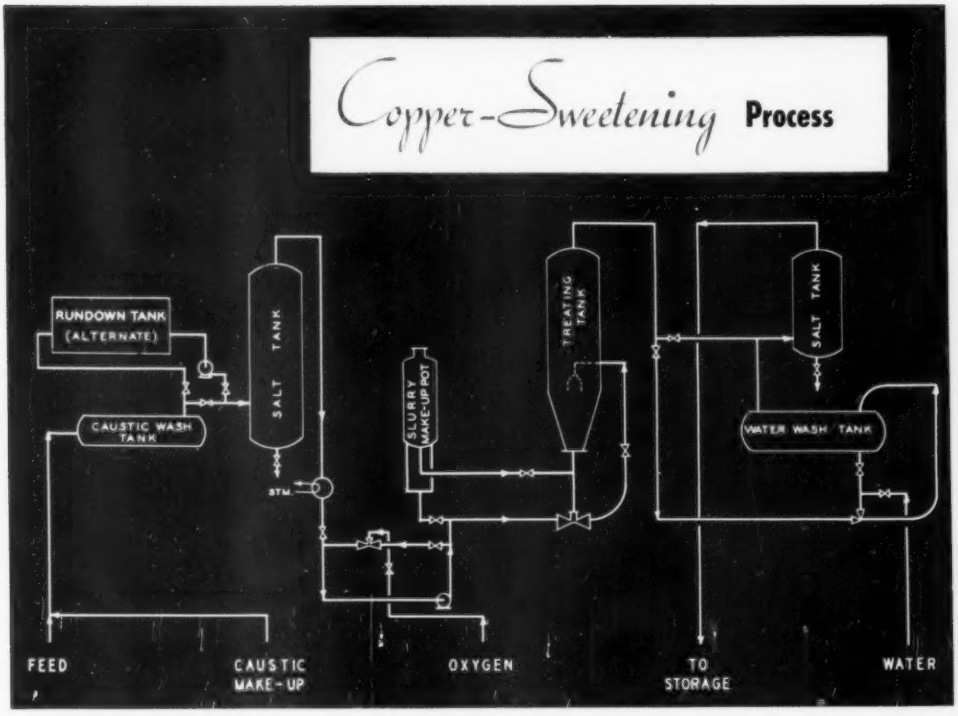
In vapor-phase extraction, the extraction step is carried out in a bubble-tray column by means of split solution flow. The raw gas is contacted countercurrently with the lean solution in the lower section of the column for removal of the bulk of the H_2S, and before its effluence as a desulfurized gas it is further contacted with the very lean solution to achieve the final degree of H_2S removal required.

In treatment of a liquid-phase hydrocarbon stream, the extraction step is achieved with countercurrent single-solution flow. After extraction, the liquid hydrocarbon flows through a solution coalescer which serves to safeguard against solution loss in the event of carryover or entrainment in the extraction column overhead.

The hydrogen sulfide recovered from this process is essentially free of hydrocarbons and is an ideal raw material for manufacture of sulfuric acid or elemental sulfur. The optimum concentration of K_3PO_4 depends upon the amount and nature of impurities of the hydrocarbon processed.

Also, since K_3PO_4 is a stable inorganic salt and does not decompose nor vaporize under treating conditions, solution loss is negligible and it does not contaminate nor polymerize the hydrocarbons. Iron and steel are satisfactory for all equipment. In case of corrosive cooling water, admiralty-metal tubes and Muntz metal sheets and baffles may be used for condenser and solution cooler. Gages, instruments, valves, and pumps should be all iron and steel. Observance of these general specifications will insure freedom from corrosion on the process side.

Discussion on this process was supplied by its licensor, Shell Development Co., New York.



THE copper-sweetening process was developed to accomplish the same final results as the doctor process—the conversion of mercaptan sulfur naturally present in hydrocarbons to disulfides—without the inherent disadvantages of the doctor method of sweetening. This process may be used for sweetening straightrun gasoline, thermally and catalytically cracked gasolines, kerosines, special solvents, and distillates.

H_2S Removal

The first step in the process involves complete removal of dissolved hydrogen sulfide from the sour hydrocarbon stock by contacting the stock with a dilute solution of caustic soda.

Separation of the caustic soda from the oil-caustic soda mixture is obtained by settling. The caustic soda solution is recirculated and hydrogen sulfide-free hydrocarbons from the settling tank are run either directly through a salt filter or, as an alternate, into a tank from which it is passed through a salt filter.

The hydrocarbon stock from the salt filter is heated sufficiently to allow the hydrocarbons to pick up the water formed in the sweetening reaction represented by Equations 1a, 2a, and 3a, below.

Mercaptan Removal

The sour stock containing mercaptans is next contacted in the liquid phase with commercial cupric chloride which reacts with mercaptan sulfur in one of the following ways:

$$\underset{\text{copper chloride}}{CuCl_2} + \underset{\text{mercaptan sulfur}}{2RSH} \longrightarrow \underset{\text{cupric mercaptide}}{CuR_2S_2} + \underset{\text{hydrogen chloride}}{2HCl} \quad (1)$$

$$2CuCl_2 + 2RSH \longrightarrow \underset{\text{disulfide}}{R_2S_2} + \underset{\text{cuprous chloride}}{2CuCl} + 2HCl \quad (2)$$

$$2CuCl + 4RSH \longrightarrow RS + \underset{\text{cuprous mercaptide}}{2CuRS} + 4HCl \quad (3)$$

By the addition of oxygen to the reaction products of Equations 1, 2, and 3, the copper salts are regenerated to the original cupric chloride and the sulfur is converted to odorless disulfides, thus:

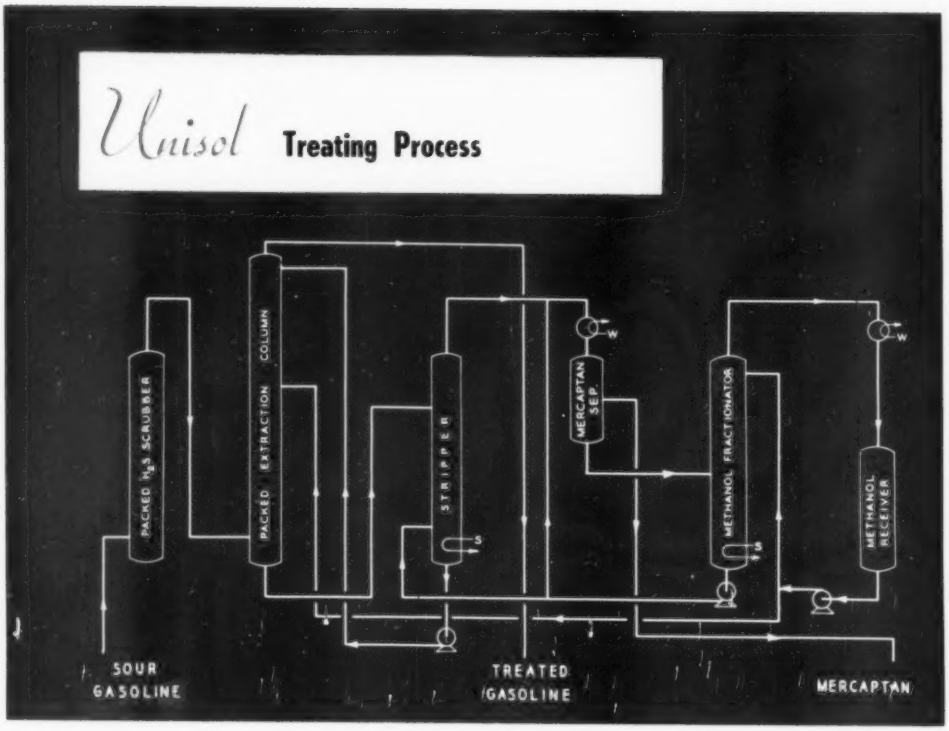
$$CuR_2S_2 + 2HCl + O \longrightarrow CuCl_2 + R_2S_2 + H_2O \quad (1a)$$

$$R_2S_2 + 2CuCl + 2HCl + O \rightarrow 2CuCl_2 + R_2S_2 + H_2O \quad (2a)$$

$$R_2S_2 + 2CuRS + 4HCl + 2O \rightarrow 2CuCl_2 + 2R_2S_2 + 2H_2O \quad (3a)$$

In actual practice the required amount of oxygen is introduced into the sour hydrocarbons stream before it is contacted with the cupric chloride; the cupric chloride is thereby continuously regenerated as it reacts with the mercaptans. Hydrocarbons are rendered sweet to the standard doctor test.

The copper-sweetening process in which commercial oxygen is used as the regeneration agent is licensed by Linde Air Products Co., New York, on a royalty-free basis for sweetening of gasolines and oils.



THE Unisol process was developed to extract mercaptan compounds from gasoline, thereby accomplishing the purpose of conventional sweetening and at the same time improving tetraethyl lead susceptibility by removal of the sulfur associated with the mercaptan. The process is based upon the large increase in solubility of mercaptans in caustic soda solutions when an organic solvent, methyl alcohol, is present.

Hydrogen sulfide-free gasoline is introduced to the bottom of an extraction column and has mercaptan extracted from it as it flows upward in countercurrent contact with an aqueous solution of methanol and caustic soda. The caustic solution is introduced at the top of the extractor and methanol near the midpoint. Above the methanol inlet the caustic solution extracts any methanol dissolved by the gasoline from the caustic-methanol solution.

Treated Gasoline

Treated gasoline is removed from the top of the extractor and sent to storage without any subsequent treating except addition of inhibitor. The fat caustic-methanol solution containing extracted mercaptan is removed from the bottom of the extraction column whence it is charged to a column in which the methanol and mercaptan are stripped from the caustic solution.

Regenerated caustic solution is recovered from the bottom of this column for reuse. From the top of the stripping column, steam-methanol-mercaptan vapors go to a condenser and then to a mercaptan separator from which the extracted mercaptans are decanted from the system. Aqueous methanol solution is charged from the mercaptan separator to a fractionating column from which methanol is recovered for reuse as an overhead product.

Mercaptan reduction of better than 99 per cent is readily accomplished by the process. Octane number improvements at the 3 cc. tetraethyl lead level, range from one to three or more on the commercial units, depending on mercaptan sulfur content of the untreated gasoline. The treated product as it comes from the unit usually is sweet or nearly sweet. In almost all cases the product is completely sweet after a few days in storage.

In comparisons of the properties of Unisol-treated gasoline with the raw gasoline or with the product obtained by conventional sweetening, it generally is found that Unisol treating improves inhibitor susceptibility, lowers A.S.T.M. gum, and that copper-dish gums after inhibiting are considerably lower.

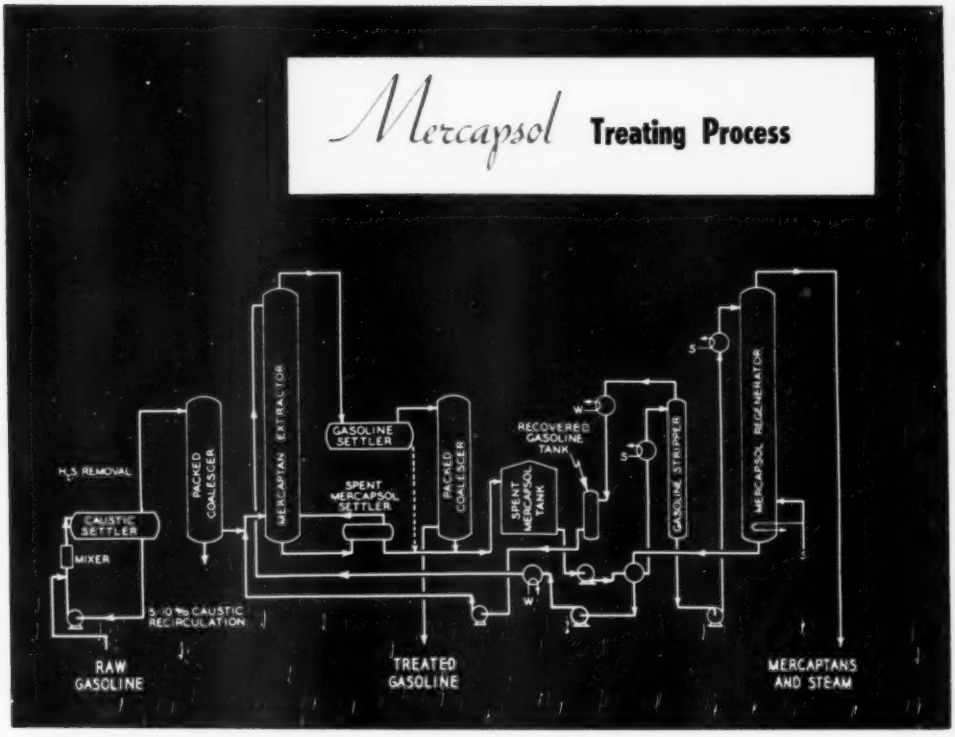
The process extracts mercaptans with a circulation of only 3-5 per cent caustic methanol. Combined chemical and utility costs average about 1 to 1½ cents per barrel treated for most gasolines.

Many gasolines contain more mercaptan than a conventional sweetening unit will successfully handle, making it necessary to remove part of the mercaptan by regenerative caustic extraction. In these cases a Unisol unit is said to cost no more to install than the combined caustic extraction plus sweetening units.

The process is the culmination of years of large-scale pilot-plant development work.

Discussion on this process, a development of Atlantic Refining Co., was supplied by its licensor, Universal Oil Products Co., Chicago.

Mercapsol Treating Process



THE Mercapsol gasoline-treating process removes mercaptans from gasoline by extraction with aqueous caustic soda fortified with certain solubility promoters. Extraction of mercaptans is ordinarily carried out in a conventional packed tower, but the process easily can be adapted to other types of extraction equipment. The extracted mercaptans are removed from the solution by steam stripping in a packed or a plate tower.

Removal of 95 to 99 per cent of the mercaptan sulfur in the raw gasoline is accomplished economically by this process. The residual mercaptan sulfur concentration of the treated gasoline is so low that its effect on odor and tetraethyl lead susceptibility is seldom detectable. If desired, doctor sweetening in storage may be attained by the addition of a suitable gum inhibitor to the treated gasoline. The savings in tetraethyl lead resulting from the substantial reduction in the total sulfur content of the treated gasoline make the process attractive in view of the recent trend toward the processing of high-sulfur crudes.

Process Operation

In the operation of the process the raw gasoline is first contacted with 5 to 10 per cent caustic soda solution for the removal of H_2S and other acidic substances. A coalescer following this step removes suspended aqueous phase from the gasoline before it enters the mercaptan extractor and prevents contamination of the permanent Mercapsol solution. Continuous countercurrent contact with regenerated Mercapsol in the extractor effects removal of the mercaptans from the gasoline. Following the mercaptan extraction the gasoline is settled and coalesced to remove and recover traces of entrained and suspended Mercapsol solution.

In the regeneration cycle spent Mercapsol from the spent solution tank is heated and then fed to the gasoline stripper. This stripper is designed to steam strip the small amount of dissolved gasoline from the solution without removing more than a small fraction of the mercaptans. The gasoline removed in this stripper is condensed, collected, and returned to the mercaptan extractor. Mercapsol from the gasoline stripper, after being brought to the correct temperature by a small trim heater, is fed to the regenerator in which open steam is used to strip out the mercaptans.

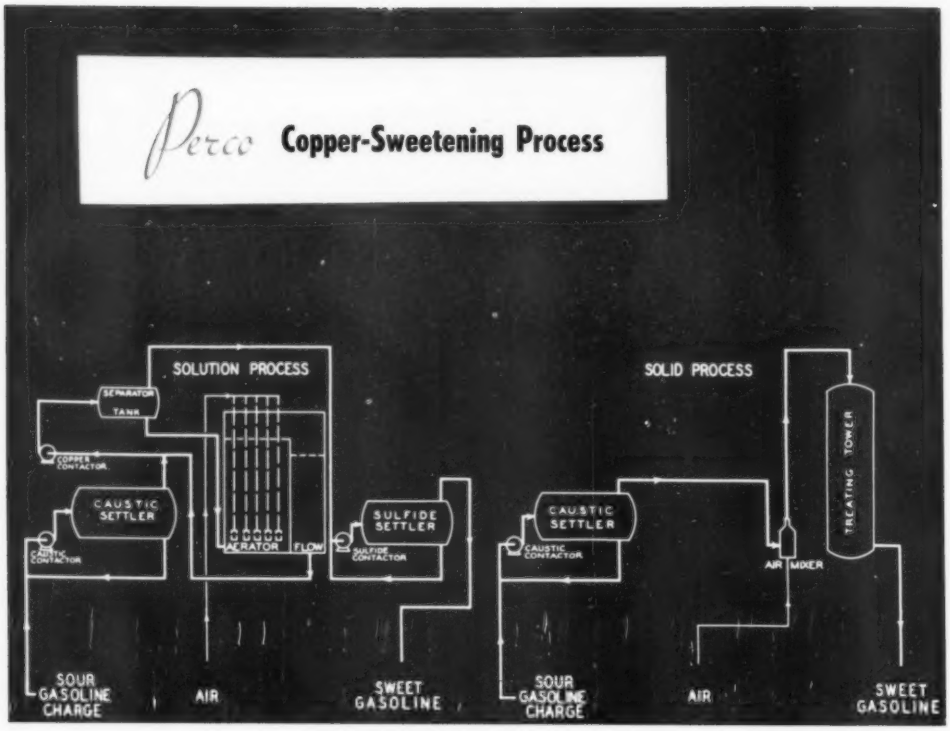
A small reboiler coil in the bottom of the regenerator serves to maintain the regenerated Mercapsol at the proper strength. The regenerated Mercapsol is cooled and charged to the mercaptan extractor. After flowing down through the extractor the Mercapsol is settled to free any entrained gasoline and returned to the spent solution tank, completing the Mercapsol cycle.

The Mercapsol solution is relatively inexpensive and can be used indefinitely if proper precautions are taken against contamination and loss.

Ultimate design of the process is governed by specifications for the finished gasoline and the properties of the raw gasoline to be treated. Existing equipment can be utilized, and such factors as cost and availability of utilities such as steam and cooling water are taken into account. By suitable instrumentation the operation of the process can be made practically automatic.

Discussion on this process was supplied by its licensor, Pure Oil Co., Chicago.

Perco Copper-Sweetening Process



THE Perco copper-sweetening process takes advantage of the oxidation of mercaptans by cupric chloride, and the subsequent regeneration of the cuprous chloride with oxygen (air) as shown by the equations:

$$\underset{\text{mercaptan}}{2RSH} + \underset{\text{cupric chloride}}{2CuCl_2} \longrightarrow \underset{\text{disulfide}}{RSSR} + \underset{\text{cuprous chloride}}{2CuCl} + \underset{\text{hydrochloric acid}}{2HCl} \quad (1)$$

$$2CuCl + 2HCl + \tfrac{1}{2}O_2 \longrightarrow 2CuCl_2 + H_2O \quad (2)$$

$$2RSH + \tfrac{1}{2}O_2 \longrightarrow RSSR + H_2O \quad (1) + (2)$$

One of the advantages of the process is the theoretical absence of chemical consumption in the sweetening step. In practice it is necessary only to make up mechanical losses of the treating solution. Other operating charges are reduced, particularly labor costs, because of the simplicity of the method.

Application

This process is applicable to any stock requiring sweetening and is especially suitable for stocks of a very sour nature, these being handled with only a slightly higher cost due to increased air requirements. This method of sweetening is applied in two ways.

Solid process.—If the stock to be treated is sufficiently stable in color and gum when treated in presence of air, it is mixed with the necessary air and percolated through a bed of absorbent material impregnated with the copper reagent.

Solution process.—Other stocks are continuously treated with the copper solution in the absence of air and the copper regenerated in a separate tank. The oxidizing power of the solution is controlled to prevent side reactions with unstable hydrocarbon constituents. Stocks treated with the copper solution are given a final sodium sulfide wash to give color and gum stability, by removing minute traces of copper which may be present in the treated oil.

In either process, if the gasoline to be sweetened contains hydrogen sulfide, this component is removed by a caustic-washing step prior to the sweetening operations. Likewise, if free sulfur is present in the stock, this compound is removed by a caustic-polysulfide treatment prior to the sweetening operations. If hydrogen sulfide and free sulfur are not present, these steps may be omitted.

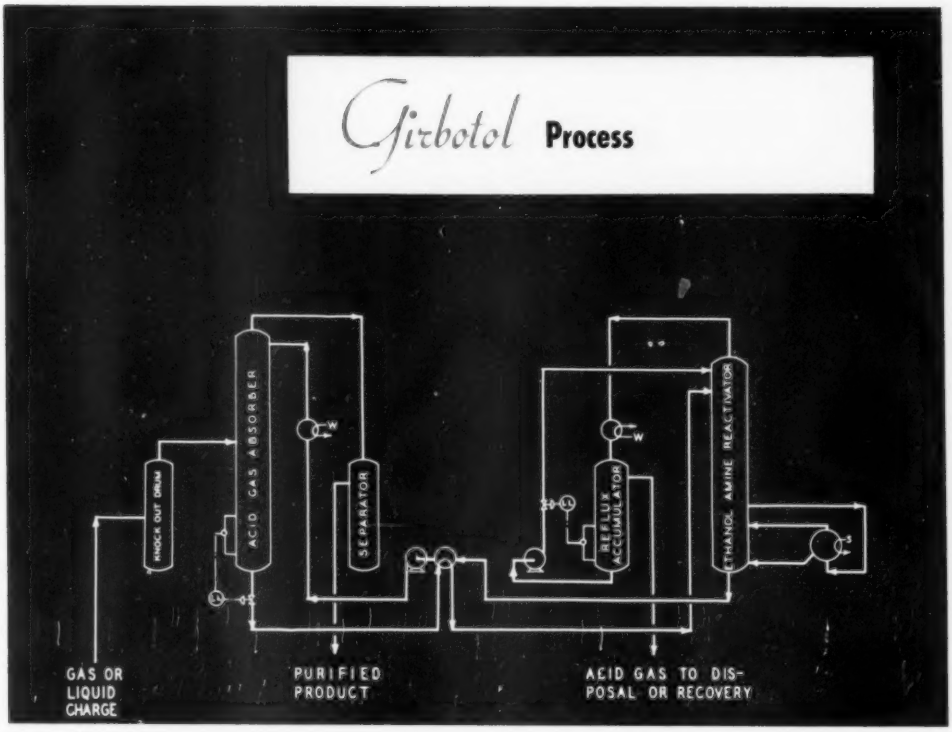
Results

The following example of liquid treatment of a cracked distillate having a 170° to 400° F. boiling range and 53° A.P.I. gravity is typical of results obtained in comparison to doctor treating.

	Sour	Doctor treated	Perco treated
Color, Saybolt	−2	−5	−2
Octane number:			
Without lead	62.9	61.9	62.9
1 cc. TEL	68.5	67.8	68.5
2 cc. TEL	71.7	71.0	71.7
Induction period, minutes:			
Without inhibitor	130	130	108
With 0.002 per cent inhibitor	320	190	415
With 0.004 per cent inhibitor	485	305	640
A.S.T.M. gum	2.6	0.4	0.0

Discussion on this process was supplied by its licensor, Perco Division, Phillips Petroleum Co., Bartlesville, Okla.

Girbotol Process



A CONTINUOUS cyclic process, the Girbotol process, separates acidic gases (such as hydrogen sulfide and carbon dioxide) from gases and liquids. The gases and liquids are scrubbed with solutions of amines (organic alkalis) which remove acidic gases from them. The absorbed acidic gases are then separated from the amine solutions by heating which regenerates the solution for further acid gas absorption. The regeneration takes place because amine salts of weak acids dissociate readily at moderately elevated temperatures, and the amines may be separated from the acidic gases they have absorbed at lower temperatures.

The process has numerous applications in the petroleum and natural-gas industries: (1) purification of natural gas for pipe-line distribution (including simultaneous hydrogen sulfide removal and dehydration); (2) purification of refinery and natural gases to eliminate corrosion, to reduce atmospheric pollution, and to recover hydrogen sulfide for conversion to elemental sulfur or sulfuric acid; (3) purification of gaseous feed stocks for polymerization and chemical plants; (4) purification of hydrocarbon liquids, including gasoline, propane, butanes, and poly feed stock; (5) removal of carbon dioxide from hydrogen and synthesis gas mixtures; (6) recovery of carbon dioxide for commercial use as liquid or as "dry ice" and for use in producing synthesis gas mixtures.

Equipment and operating cycle of a Girbotol plant are similar to those of an oil-absorption plant. The raw feed (gas or liquid) is passed through a contactor countercurrent to a stream of lean amine solution that removes hydrogen sulfide and or carbon dioxide from it. The purified product passes out the top of the contactor to utilization, while the rich amine solution, containing absorbed hydrogen sulfide and or carbon dioxide, flows through a heat exchanger to a stripper (reactivator) in which the acid gases are separated from the solution by indirect heating and steam stripping.

The acid gas and steam from the overhead of the reactivator passes through a condenser. The steam is condensed and returned to the system and the acid gas is flared or recovered. The lean amine solution from the base of the tower returns to the contactor after heat exchange with the rich amine solution and additional cooling.

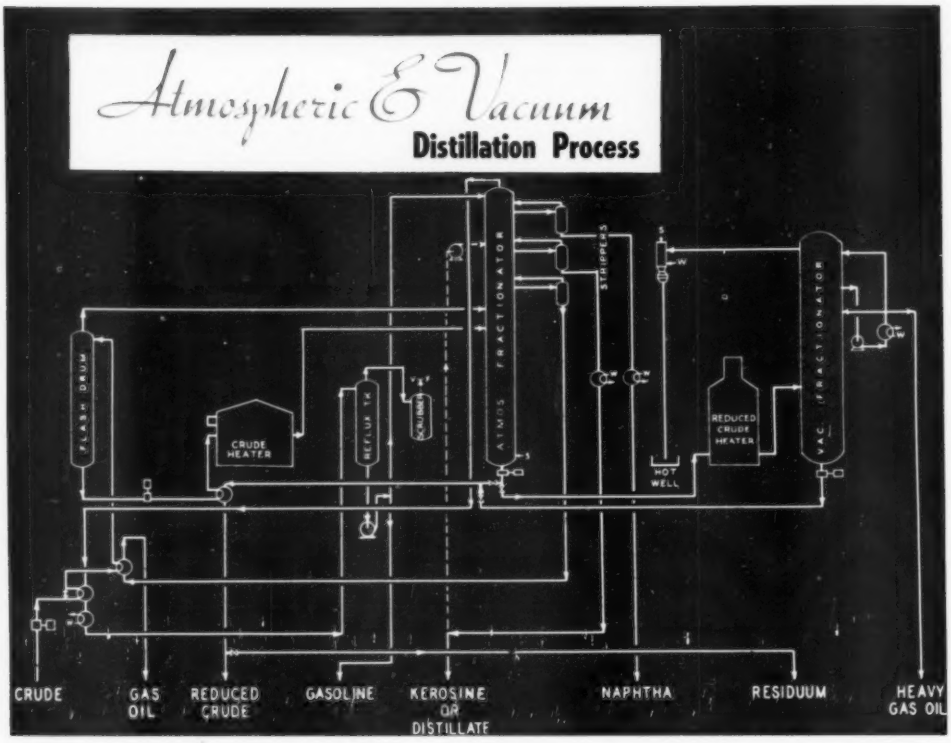
Modifications

A number of modifications have been introduced into the basic Girbotol plant cycle in recent years.

The use of solution reactivation under increased pressures results in an increased acid-gas capacity of the amine solution over the capacities obtainable with atmospheric pressure reactivation with a consequent increase in investment and operating costs of the plant. The use of suitable antifoaming agents such as ocenal (oleyl alcohol) eliminates solution carryover where such carryover is the result of foaming due to impurities in the gas.

Two-stage absorption and reactivation results in greater ease of purification and decreased utility consumption. Solution recovery by distillation in the presence of sodium carbonate or by extraction eliminates difficulties encountered when oxygen is present in the gas stream. The use of mercaptan plant stripping steam for reactivation of the amine solution results in a combination savings of utilities.

Discussion of this process was supplied by its licensor, Girdler Corp., Louisville.



THE accompanying diagram shows the essential steps in the primary distillation of crude oil. The first step is the "skimming" or "topping" operation which is usually carried out at substantially atmospheric pressure. The crude is usually preheated by exchange with hot products leaving the unit, after which it goes to a flash drum or some type of desalter, depending upon the characteristics of the crude being processed. If the salt content is greater than 10 lb. per 1,000 bbl. some type of desalting is usually desirable. If a high-gravity crude is being charged, a flash ahead of the fired pipe still will reduce the required diameter of the still tubes for any given heater coil pressure drop. Thus, flashing ahead of the pipe still becomes an economic question which requires study for each specific installation.

From the desalter or flush drum the crude is pumped through more heat exchangers and a pipe still and heated to the temperature necessary to secure the desired product separation in the fractionator. Straightrun gasoline or light naphtha is taken overhead, while heavy naphtha, kerosine, burning oils, diesel fuel, and light gas oils may be removed as side streams. Steam strippers are usually employed on the side streams to vaporize and return to the tower the lightest portions of the withdrawn liquid, thus narrowing the boiling range and raising the flash of the side stream products.

The second step is the vacuum distillation of the bottoms from the atmospheric fractionator. These bottoms are usually heated in another tube still and flashed into the vacuum fractionator. The flow diagram indicates the atmospheric tower bottoms going to either the reduced crude heater or to reduced crude storage. As shown, the vacuum unit is either run in combination with the atmospheric unit or is down altogether. By the addition of a reduced-crude heater charge pump to take suction on the reduced-crude storage tanks, and by designing the reduced-crude heater for the increased duty, the vacuum unit may be operated separately, entirely independent of the atmospheric skimming unit.

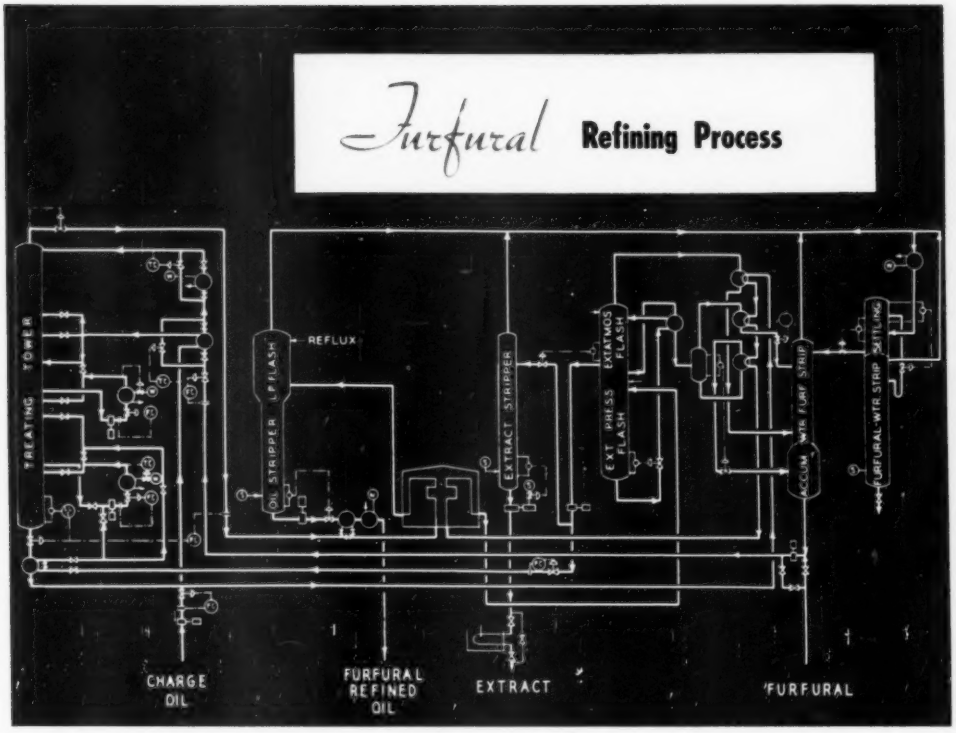
In the vacuum fractionator heavy gas oil or a lube-oil fraction may be removed as a side stream as shown, or as an overhead product if a surface condenser is used on the overhead vapors. Asphalt or residuum, which may be blended back for heavy fuel, is the remaining bottom product.

The diagram indicates, in general, fairly conventional methods, but innumerable variations may be introduced and often may be required to fit specific conditions. Such a variation is indicated by the dotted side reflux return to the atmospheric fractionator. By returning a portion of the cooled side-draw liquid as reflux to the tower it is possible to reduce the vapor load (and hence vessel diameter) of the upper portion of the tower and to get better end-point control of the side cut.

The type of pumps and drivers is dependent on the size of the unit and the utility balance of the refinery in which it is installed. The temperature range of the process is within the limits of carbon-steel construction but the use of alloys to minimize corrosion is usually justified when the unit is to handle sour high sulfur crude.

Discussion on this process was supplied by Jones & Laughlin Supply Co., Tulsa.

Furfural Refining Process



FURFURAL is an extractive solvent extensively employed for refining a wide range of distillate and residual lubricating oil stocks, diesel fuel oils and gas oils. Furfural originally was selected as most suitable for the solvent extraction of lubricating oils because of its high degree of selectivity without the addition of water or other modifying agent for undesirable compounds. Furfural also was chosen because of its stability, low cost, availability and its desirable physical characteristics. Being nonacidic and nontoxic, furfural can be handled without special protective provisions. Its boiling point is sufficiently low (323° F.) to permit its recovery from the lightest lubricating-oil stocks and even from diesel fuel oil or furnace oils without appreciable loss of oil or solvent. Its low solid point (—38° F.) eliminates danger of solidification in lines or tanks in cold weather. The high specific gravity of furfural insures complete separation quickly in extraction towers of relatively small diameter. The critical solution temperature of furfural is high enough to permit its application to waxy or viscous oils at temperatures that insure treatment in the nonviscous, nonwaxy range.

Improves Burning Quality

Furfural is used to extract diesel oils, gas oils, furnace oils, and catalytically cracked stocks for cetane improvement, sulfur and nitrogen reduction, metal-contaminant removal, and improvement in burning quality.

The furfural extraction unit represented by the accompanying flow diagram comprises an extraction or treating section, a raffinate-recovery section, an extract recovery section, water-removal facilities, process surge tanks, and pumping equipment. Furfural, however, because of its stability over a wide range of operating conditions, lends itself to a variety of methods of recovery from raffinate and extract solutions. Different types of the solvent recovery systems have been developed and used, in order to provide for maximum operating economy of each particular installation.

Continuous Extraction

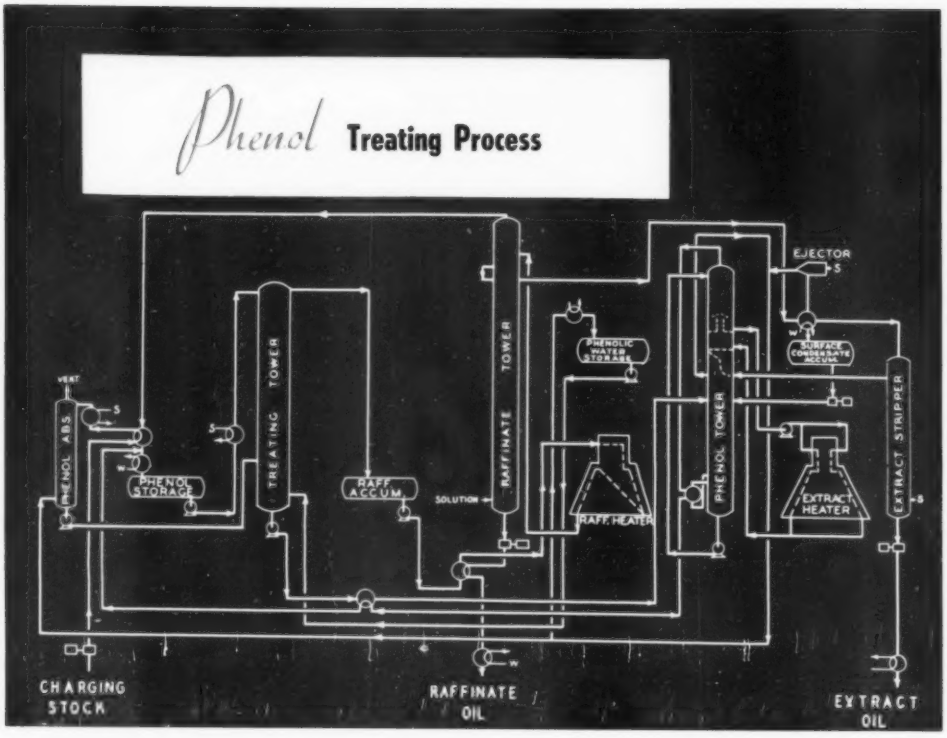
Untreated oil is introduced into a continuous countercurrent extractor at a predetermined temperature. The temperature of the furfural charged into the extractor varies depending on the charge stock. A substantial temperature gradient is maintained between the top and bottom of the tower by indirect water coolers.

Concentration of undesirable oily constituents in the furfural phase increases toward the bottom of the tower from which the extract solution is withdrawn continuously. Conversely, the oil quality improves toward the top of the tower from which practically all oil of predetermined raffinate quality that is present in the charge stock overflows with a small percentage of furfural dissolved in this phase.

Besides the development of a highly efficient treating tower, in which an increased degree of fractionation is obtained between the relatively insoluble, desirable lubricating-oil fractions and the more soluble fractions, the flow through recently designed units has been considerably simplified.

The furfural refining process is licensed by Texaco Development Corp.

Phenol Treating Process



THE phenol extraction process is a liquid-to-liquid extraction process for improving viscosity index and oxidation resistance, and for reducing carbon and sludge-forming tendencies for lubricating oils.

The process is employed successfully either before or after dewaxing on both distillate and residual oils from all types of crudes. The selective solvent employed—phenol—gives high yields of desired products and has exceptional stability. The solvent is continuously reused, with low losses (0.01 per cent of the total solvent circulated per day in well-operated plants). The high solvent power of phenol necessitates only comparatively low ratios of solvent to oil.

In the operations of modern continuous phenol-extraction plants, vertical countercurrent extraction towers having high oil-charge rates per unit of cross-sectional area are employed. By utilizing heat from the condensing of phenol vapor to vaporize solvent going to the extract-recovery system, appreciable reduction in heat requirements is realized.

Process Flow

Raw stock and dry phenol are fed into the treating tower. Prior to entering the treating tower, the feed stock flows through the phenol absorber tower to remove the remaining phenol from process water being discharged from the plant.

Raffinate Phase

Raffinate phase is withdrawn from the top of the treating tower to the raffinate storage drum from which it is fed through a heat exchanger, exchanging heat with the treated raffinate oil, thence through a coil in the raffinate furnace and is flashed into the evaporator section of the raffinate tower at substantially atmospheric pressure. Phenol vapor recovered in this section flows to the phenol condenser and enters the phenol storage tank.

Extract Phase

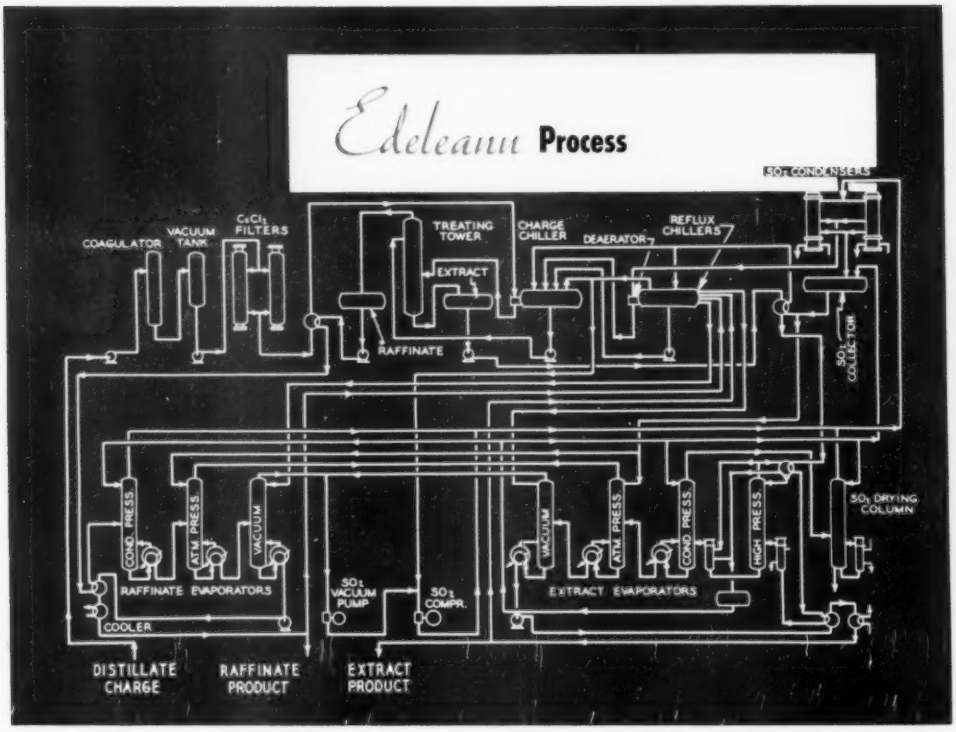
The extract phase is withdrawn from the bottom of the treating tower, fed through heat exchangers, and enters the drying section of the phenol tower in which all water is removed as constant-boiling phenolic water vapor. The phenolic water vapor leaving the top of this section is condensed and enters the phenolic water drum from which is drawn reflux for the drying section, as well as the water required for modification of solvent at the bottom of the treating tower.

Dry extract solution is pumped from the bottom of the drying section of the phenol tower to the top of the evaporator section of the phenol tower where a portion of the solvent is flashed off. Phenol vapor recovered in this section flows through exchangers into the phenol storage drum. The remaining extract drops to a pan in the evaporator section of the phenol tower and is pumped through a coil in the extract furnace returning to a point below the pan in the evaporator section of the phenol tower.

The last traces of dissolved phenol contained in the extract oil from the evaporator section are removed in the extract stripper. Stripped extract is delivered to storage.

M. W. Kellogg Co., licensing agent, supplied this discussion. Licenses are under the patents of Standard Oil Co. (N. J.), Union Oil Co. of California, Standard Oil Co. (Ind.), and M. W. Kellogg Co.

Edeleanu Process



THE Edeleanu process is a selective extraction process employing liquid sulfur dioxide as the solvent. The process is employed in the refining of naphtha, kerosine, gas oil, and light lubricating oils. It is equally suitable for treatment of medium and heavy lubricating oils, but for that purpose it must be used under temperature and pressure conditions which make its application less attractive from a practical standpoint.

Sulfur dioxide exhibits its highest selectivity at temperatures below atmospheric. The optimum extraction temperature varies with the boiling range of the oil to be treated and with the desired degree of separation. For maximum concentration of aromatics in the extract, the treating temperature should be fixed as low as is economically feasible.

The quality of the raffinates will increase with the solvent ratio used, while that of the extract, as expressed in terms of aromatic concentration, will increase with decreasing temperature maintained in the extract phase.

For the treatment of naphthas, solvent ratios of 50 to 100 volume per cent are commonly applied. The raffinates obtained will have a low sulfur content and a high aniline point, while extracts are of high solvency (Kauri butanol numbers of 65 to 70).

The kerosine treatment will take 50 to 100 volume per cent of solvent of lamp oil, and up to 150 per cent for high-quality specialties. A treatment with 100 per cent of SO_2 at 15° F. will raise the smoke point by 10 to 15 points and will reduce the sulfur content to about 20 per cent of the original.

The treatment of gas oils for the production of high-speed diesel fuel will usually take not over 100 volume per cent of solvent. Consistent with their high paraffinity the raffinates will have a high cetane value and aniline point. The effect of the treatment on the sulfur content is similar to that obtained in kerosine treatment.

In the recovery of solvent from the raffinate and extract, three stages of evaporation are commonly employed, the first stage connected to water-cooled condensers and operating at 50 to 80 psig., and atmospheric stage served by the compressors and a final stripping stage operating under vacuum. Temperature levels are moderate, so that live and exhaust steam are the only source of heat required. With treating ratios in excess of 50-60 per cent, a double-effect evaporation may be used in the extract-recovery system, with a preflash stage usually held at 200 psig. and the vapor from this stage condensed by heat exchange with the flash residue. In plants designed for treatment of naphthas only, the vacuum evaporators are omitted.

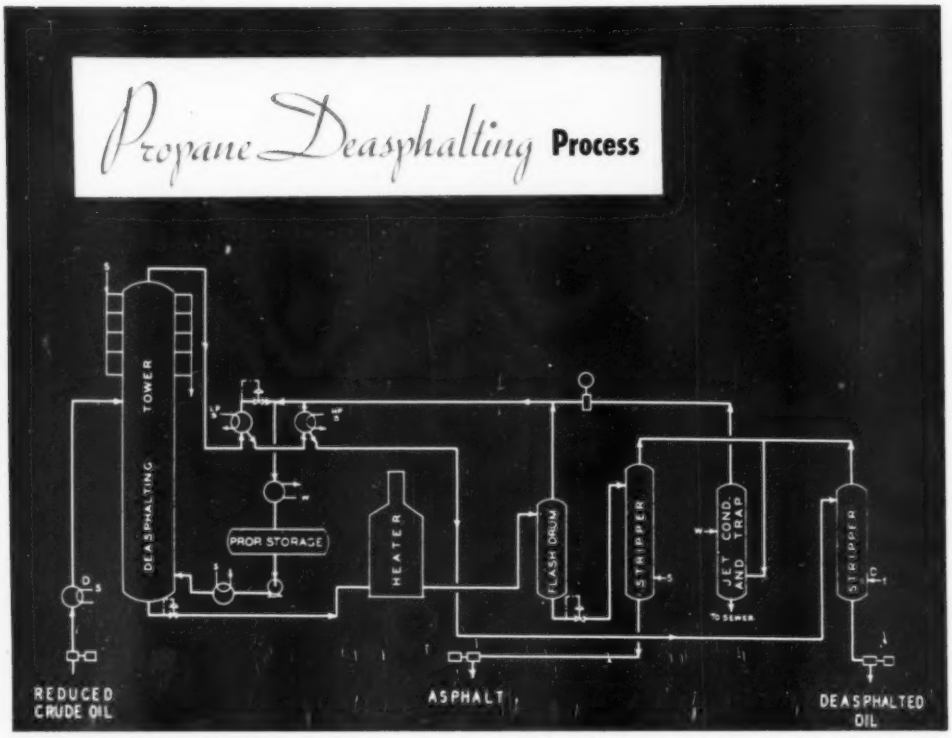
All solvent recovered from the products is ultimately liquefied and returned to the system.

For the production of highly aromatic extracts (from any stock dealt with herein) some refiners have employed extract phase temperatures down to —20° F. In one unit SO_2 has been used in conjunction with an aliphatic stripping agent to produce nitration-grade toluene from hydroformed naphthas.

In spite of the potentially corrosive nature of the solvent, Edeleanu plants have a long life and require little maintenance. The yearly turnaround of these plants usually takes no more than 4 to 5 days.

Discussion of this process supplied by E. B. Badger & Sons Co., Boston.

Propane Deasphalting Process



THE propane deasphalting process employs propane as a solvent for the purpose of separating by liquid-to-liquid extraction asphalt, color bodies, and other undesirable constituents from reduced crudes and for fractionating the clean oil thus produced into portions having different viscosities.

Ability of the process to produce oil of excellent color and low carbon residue is completely independent of the asphalt content of the reduced crude. This fact, coupled with a low operating cost, makes it possible to produce lubricating oils from reduced crudes previously considered unsuited for the purpose.

Employs Fractionation

The process is also employed for fractionation of the deasphalted oil into two or more portions. By a simple variation of operating conditions, the highly viscous oil portions of reduced crudes may be separated into as many different fractions as is desired. Because all separations made with propane are carried out at relatively low temperatures, no cracking occurs.

Reduced crude is pumped through a steam heater into the upper portion of the deasphalting tower. Propane is pumped into the lower portion of the deasphalting tower from where it flows upward countercurrently to the descending asphalt phase.

Deasphalted oil is withdrawn overhead and flows to a low-pressure-steam propane evaporator, where a large amount of propane is flashed overhead through a condenser into the propane storage tank. The deasphalted oil-propane solution flows from the low-pressure-steam propane evaporator to the high-pressure-steam propane evaporator where the majority of the remaining propane is flashed off, joining the stream from the low-pressure-steam evaporator. The oil flows from the high-pressure-steam evaporator into a stream stripper, where the remaining propane is removed.

Propane vapor and stripping steam from the asphalt and deasphalted oil strippers are taken to a jet condenser and trap where the steam is condensed. Vapor from the jet condenser is picked up by a compressor, condensed, and delivered to a propane-storage tank.

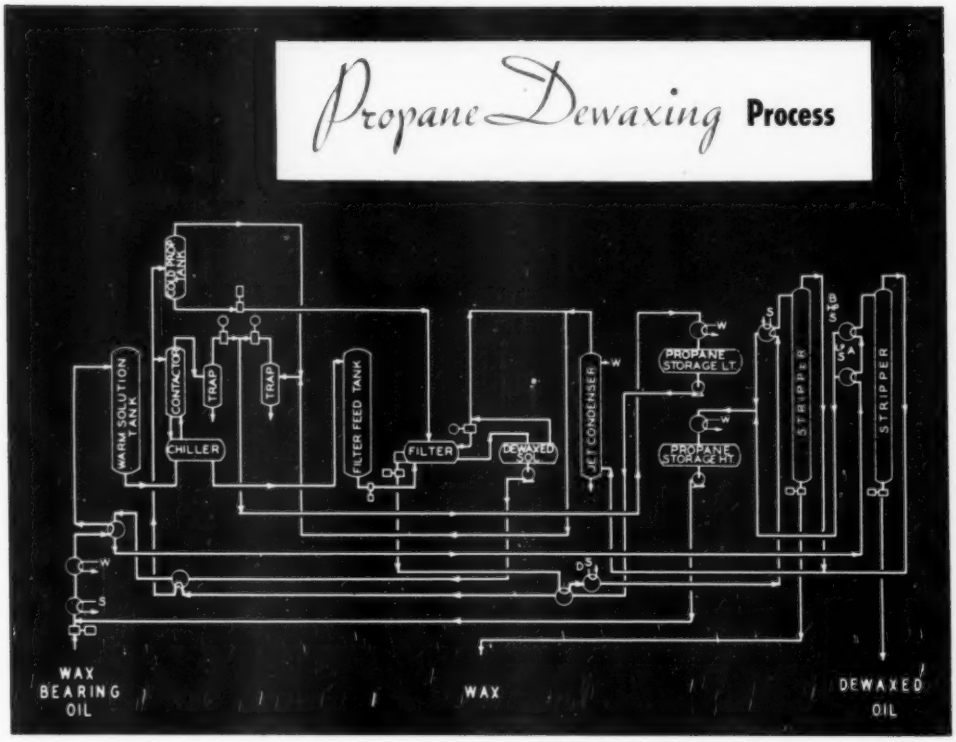
Asphalt Solution

The asphalt solution is withdrawn from the bottom of the deasphalting tower and passes through a furnace and thence to a flash drum where the greater part of the propane is flashed overhead, joining the combined propane streams from the low-pressure and high-pressure-steam propane evaporators. The asphalt with remaining small percentage of propane is withdrawn from the bottom of the flash drum into a steam stripper, where the remaining propane is removed.

Stocks treated by this process are suitable for additional processing by single solvent extraction to produce high-quality lubricating-oil stocks. The process is frequently employed in combination with propane dewaxing and other single-solvent treatment for producing lube stocks from certain types of reduced crude oils.

M. W. Kellogg Co., licensing agent, supplied this discussion. Licenses granted are under the patents of Standard Oil Co. (N. J.), Union Oil Co. of California, Standard Oil Co. (Ind.), and M. W. Kellogg Co.

Propane Dewaxing Process



THE propane dewaxing process is employed for separating wax from crude oil in lubricating-oil manufacture. The solvent, propane, is the only extraneous material used in the process since it serves both as a refrigerant and a solvent for the oil.

Economic features of the process are its low operating cost and wide adaptation to any type of lubricating stock. High yields of dewaxed oil of zero pour test or lower and wax of low oil content are obtained.

Low-Temperature Operation

Oil and propane are charged continuously under flow control, warmed to dissolve all the wax, and sent to a chilling vessel in which reduction of temperature to approximately—40° F. is effected by allowing propane to vaporize directly from the solution.

Wax crystallizes out at this low temperature and is separated from the oil on a continuous rotary pressure filter of most modern design.

The filter cake is washed with cold liquid propane to remove oil adhering to the wax crystals and then transferred by means of a screw conveyor and wax pump to propane-recovery equipment.

Dewaxed Filtrate

The dewaxed filtrate also is sent to a propane-recovery unit. Both end products—dewaxed oil and wax—are pumped from the strippers to storage tanks. Over-all loss of the propane solvent is low and control methods for the process are relatively simple.

Two compressors are employed in the low-temperature propane circuit of the process. The high-temperature circuit connects into the unit's propane evaporators. Propane vapors from the evaporators are condensed and delivered into high-temperature storage from which the solvent liquid is pumped into the wax-bearing oil charge stream. The two strippers in the process are connected to a jet condenser which in turn is connected into the low-temperature propane circuit via the suction side of one of the compressors. Intake of the second of the two compressors is connected only into contactor via a trap.

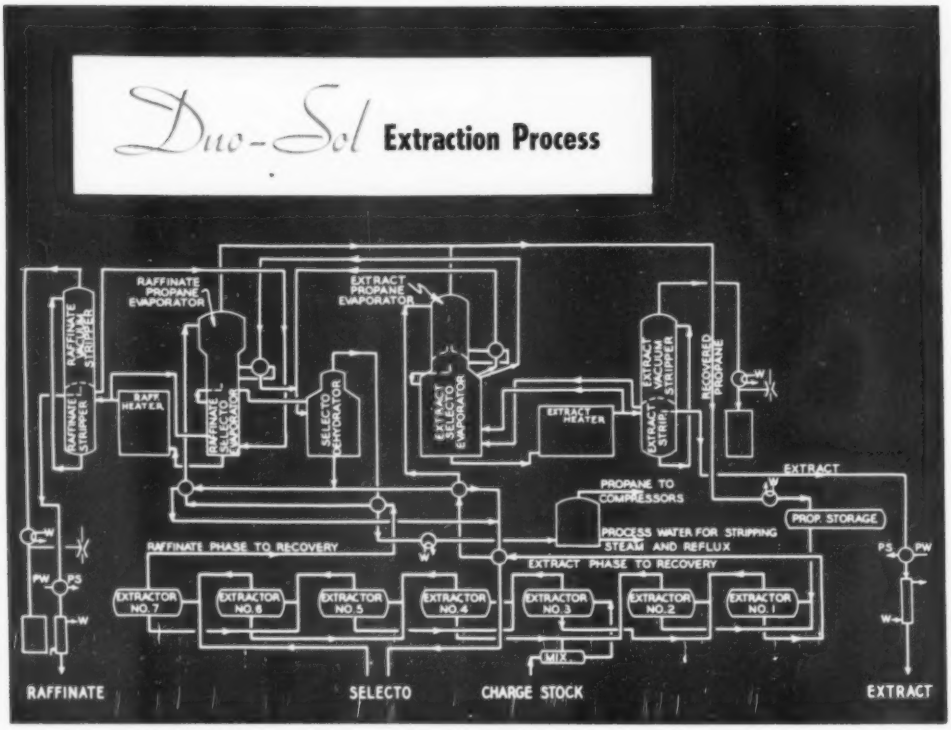
The low cost of propane, its double duty as a solvent and refrigerant, and its ease of recovery are features of the process which make for high efficiency.

Various waxy oils may be successfully and economically dewaxed by this process. Typical of some stocks being treated by propane dewaxing are those from Mid-Continent and East Texas crude oils. With prior treatment by propane deasphalting and phenol extraction, heavy distillates and other lubricating-oil stocks from these crude oils respond readily to propane dewaxing.

Propane dewaxing is often employed in combination with propane deasphalting and acid treatment in propane solution.

M. W. Kellogg Co., licensing agent, supplied this discussion. Licenses are under the patents of Standard Oil Co. (N. J.), Union Oil Co. of California, Standard Oil Co. (Ind.), and M. W. Kellogg Co.

Duo-Sol Extraction Process



DUO-SOL extraction is a process for the manufacture of lubricants in which two solvents are used countercurrently to achieve separation between desirable and undesirable compounds in a lubricant charge stock. The process employs as one solvent, propane, which has a high solubility for the raffinate and, as a second solvent, selecto, a blend of cresol and phenol which has a high affinity for the extract or undesirable components such as: asphalt, asphaltines, unsaturates, and color bodies.

The solvents themselves have only limited solubility for each other and, therefore, whenever mixed with oil in proper proportions form into a heavy extract phase containing selecto, extract, and little propane, and a light raffinate phase containing propane, raffinate, and little selecto. These phases are readily separated by gravity.

Extraction System

The extraction system consists of seven extractor vessels. In each of these extractors the charge of solvents and oil is mixed and then settled into a raffinate and extract phase which leave the vessel from the top and bottom respectively.

Fresh propane is charged into the first extraction vessel together with the extract from the second extraction vessel. The final extract phase leaving the system is discharged from the first extractor while the raffinate layer from the first extractor passes on to the second extractor.

Fresh selecto is charged to the seventh extractor together with raffinate from the sixth extractor. The final raffinate phase from the seventh extractor leaves the extraction system while the extract from the seventh extractor is pumped to the sixth extractor.

Charge stock is introduced into the third extractor where an initial separation of raffinate and extract occurs. This extract passes countercurrent to the propane through extractors 2 and 1, stripping the extract of any desirable components. The raffinate from the third extractor passes through extractors 4, 5, 6, and 7 and is successively treated with greater and greater concentration of selecto which removes all undesirable materials in the raffinate.

Solvent Recovery

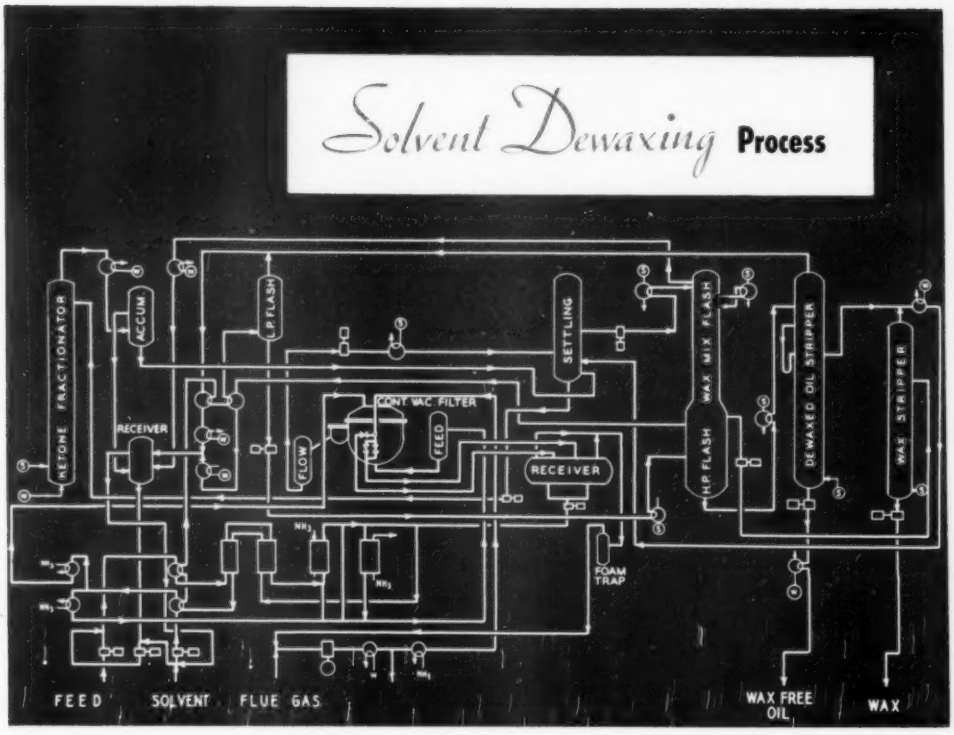
The solvent-recovery system is so designed that heat is supplied only for the evaporation of selecto while the selecto vapors and liquid supply all heat required for evaporation of propane and the outgoing products supply the heat necessary for the generation of all process steam. Thus, fuel is required only for the recovery of the one solvent, selecto.

The process is unique among solvent processes in its ability to handle residual charge stock without first removing the asphalt from the oil portion and, therefore, for operations which employ residual charge stocks for the manufacture of lubricants.

The Duo-Sol process, whether operating on neutrals, residual charge for bright stock, or long residual stock which is later rerun, inherently produces fine-colored oils with very low carbon residue and excellent stability, thereby greatly decreasing clay requirements for finishing oils.

Discussion on this process was supplied by its licensor, Max B. Miller & Co., Inc., New York.

Solvent Dewaxing Process



THE solvent dewaxing process generally employs a mixture of methyl ethyl ketone and an aromatic solvent (benzol, toluol, or a mixture of both) as the solvent to obtain a dewaxed oil pour point equal to or within a few degrees of the dewaxing temperature. The dewaxed oils are free from wax cloud and there is no rise in pour point or "pour reversion" on aging. Due to low solubility of wax in the solvent, extremely low pour points can be obtained at relatively high separation temperatures. Either distillate or residual stocks in the raw state or refined, of any viscosity, can be dewaxed.

Simplicity of operation, flexibility, relatively low construction and operation costs, the absence of special equipment, special alloys, high pressure, excessively low operating temperatures, and the ability to obtain high dewaxed oil yields and very low-oil-content waxes are characteristics of the process.

The wax contained in lubricating-oil stocks when properly crystallized from a chilled solution in the solvent mixture is particularly adaptable to removal by filtration. Practically complete separation of oil from wax is obtained by use of a cold displacement wash. The use of a closed flue gas system minimizes fire hazards and solvent losses. Dilution solvent dosages vary from a solvent-to-oil ratio of 1.0:1 to as much as 4:1, depending upon the nature and viscosity of the charge stock.

Proper conditioning of the charge to the filters by controlled application of solvent has increased dewaxed oil yield, reduced oil content of the wax to an extremely low figure, and reduced the amount of solvent circulated per barrel of oil charged. An additional development has been the production of wax, without addition agents, concurrently with the production of low-pour-point oil, but in auxiliary equipment operated as a separate process.

The accompanying flow diagram, upon which it is impractical to reflect all of the recent improvements, shows the flow through the principal chilling, filtering, and solvent-recovery equipment.

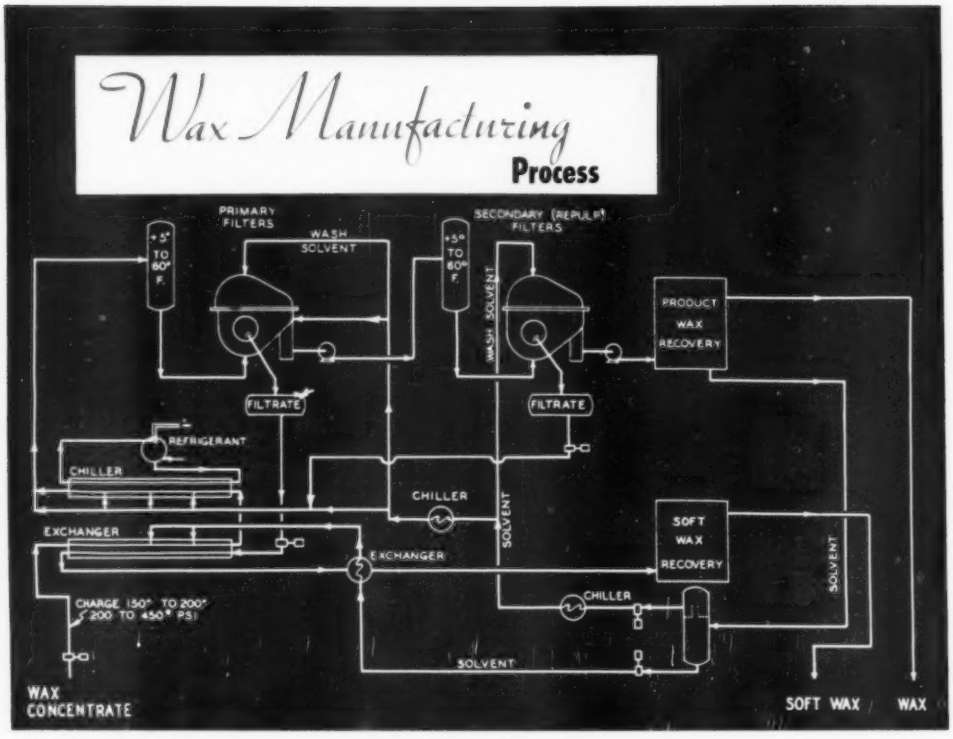
Dilution solvent is introduced into the charge oil stream in such amounts, at selected points in the chilling cycle, as to insure a wax crystal structure and liquid viscosity most suitable for filtration. The chilled charge mixture flows from the double pipe chillers through a filter feed tank to drum-type vacuum filters in which compartmentized, cloth-covered drums rotate half submerged in enclosed filter cases.

The wax cake deposited upon the drum during filtration is washed with cold solvent as it emerges from the liquid level in the filter. Just before each of the filter drum compartments reaches the wax deflector, flue gas at low pressure is admitted through a blow-back connection to the underneath side of the filter cloth. The bond between wax and cloth is broken and the washed wax falls into the wax-discharge compartment.

The filtrate from the main filtrate receiver is pumped through double pipe exchangers to evaporators for recovery of the solvent. Heat for evaporating the solvent from the dewaxed oil solution and wax mix may be supplied by either steam or fired heaters.

Consistent uniformity in operating conditions and product quality is an inherent characteristic of the process. There are no corrosion problems and low-pressure equipment is used throughout.

The solvent dewaxing process is licensed by Texaco Development Corp.



THE wax manufacturing process is operated for the production of oil-free, high-quality wax and generally employs a mixture of the same solvents as those used in the solvent dewaxing process. The two processes can be operated concurrently in a single plant using the same solvent supply.

The wax manufacturing process is characterized by an operating technique involving the crystallization of wax or a selected portion of the wax contained in the petroleum oil or waxy concentrate by first cooling in the absence or substantial absence of solvent, then adding solvent in small increments until all of the desired wax types have crystallized. Sufficient cooled solvent is then added to the cooled waxy slurry to permit separation of the solid wax from the liquid phase by filtration.

Oil in the wax cake is washed continuously from the wax by displacement with cold solvent. The total wax cake is continuously removed from the filter and additional solvent mixed or repulped with the wax slurry at a temperature necessary to retain any remaining oil and low melting point, undesirable wax fractions in solution.

The repulped slurry is continuously filtered upon a second filter on which the final product wax is again washed. Cake from this filter is pumped to the solvent returned to the solvent supply tanks.

Filtrate from the secondary filter, containing a small amount of oil and undesirable soluble wax fractions, is pumped to the solvent-recovery equipment from which the "soft" wax is delivered to storage tanks and the solvent returned to the system.

Crystalline and microcrystalline waxes with melting points ranging from below 120° F. to above 170° F., depending upon the nature of the charge stock, can be produced by this process.

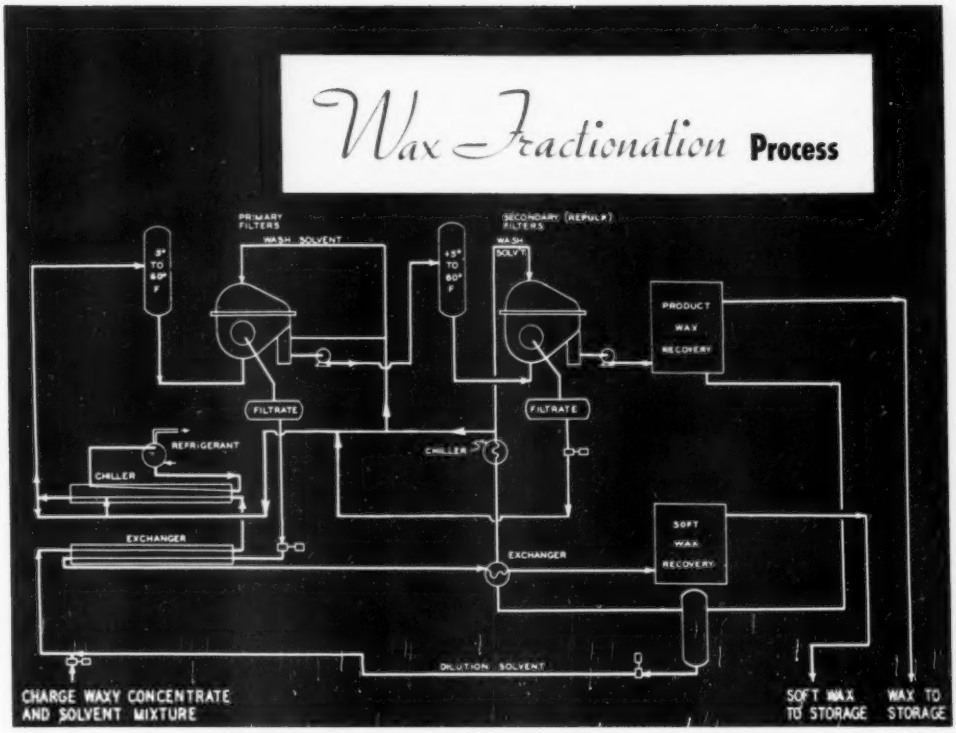
Combined Operation

As in the case of the wax fractionation process, this process is operated either independent of, or in conjunction with the solvent dewaxing operation. In a typical combined operation of the solvent dewaxing and wax manufacturing processes, low-pour-point dewaxed oil and oil-free wax are produced concurrently. This operation is continuous and highly economical in the use of solvent whether producing regular grades of white crystalline wax and dewaxed neutral oils or high-melting-point, microcrystalline wax from distillate or residual oils.

Over-all solvent dosages for both the dewaxing and maximum manufacturing operation vary from a solvent-to-oil ratio of approximately 2.5:1 for low-viscosity distillates to 7.0:1 for viscous residual stocks containing microcrystalline waxes.

The process yields waxes of very high quality and of precise fractions not normally obtained by any other method. Crystalline waxes produced consistently show oil contents by A.S.T.M. analysis that are below 0.3 per cent and with certain types of crystalline waxes below 0.1 per cent.

The wax manufacturing process is the development of Texaco Development Corp. and Union Oil Co. of California. Texaco Development Corp. is licensor.



THE wax fractionation process is operated for the production of wax of low oil content and generally employs a mixture of the same solvents as those used in the solvent dewaxing process. The two processes can be operated independently and concurrently in a single plant, using the same solvent supply, and charging the wax cake, comprising wax and solvent from the dewaxing operation, directly to the wax fractionation operation without first recovering the solvent from the wax.

The wax fractionation process employs an operating technique involving the crystallization of wax or a selected portion of the wax contained in a waxy concentrate in the presence of a substantial amount of solvent, which solvent is added to the charge stock before any of the wax is crystallized.

Operation Combined with Solvent Dewaxing Process

Typical of the combined operation of the solvent dewaxing and wax fractionation process is a case in which low-pour-point dewaxed oil and wax of low oil content are produced concurrently. Here, a mixture of the wax-bearing charge stock with a substantial amount of solvent is chilled to a temperature suitable for the production of dewaxed oil of the desired pour point. The mixture is then filtered and oil-bearing solution in the wax cake is washed continuously from the wax by displacement with cold solvent. The wax cake without the removal of solvent is continuously discharged from the primary filters and heated until the wax is totally dissolved in the solvent. Additional warm solvent is blended with the wax cake solution and the mixture cooled to a predetermined temperature necessary to crystallize the desired wax fractions and obtain the proper quality of wax. The recrystallized wax is then continuously separated by means of a second filter on which the product wax receives a final wash.

Solvent Dosages Vary With Feed Stocks

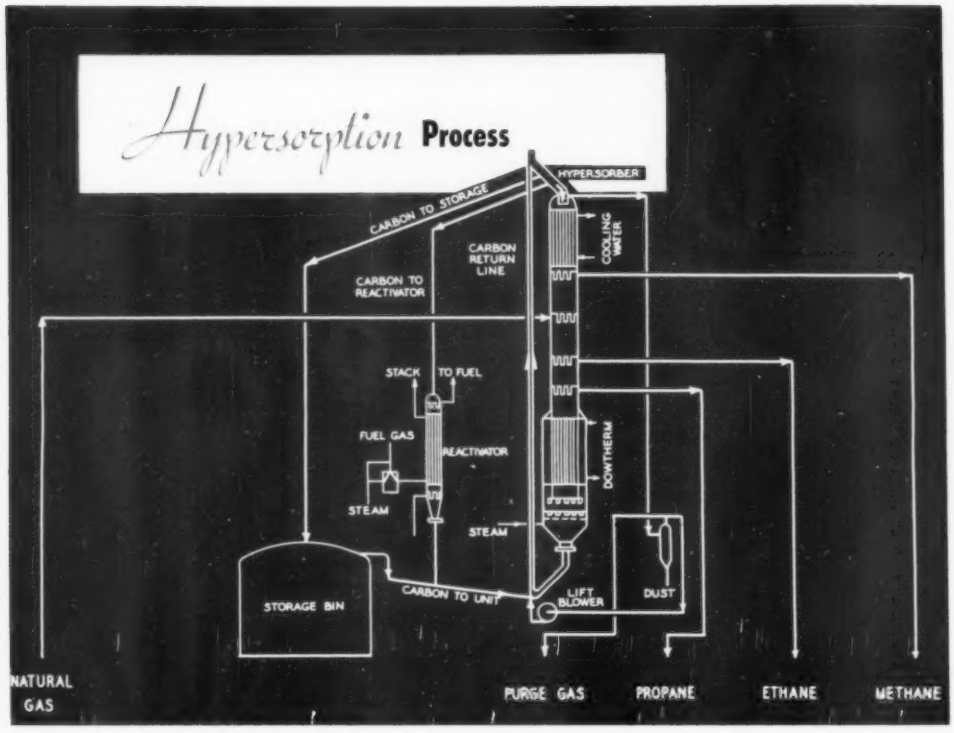
Over-all solvent dosages for a combined dewaxing and wax fractionation operation vary from a solvent-to-oil ratio of approximately 3.5:1 for low-viscosity lubricating-oil distillate stocks to 9.0:1 for viscous residual stocks.

The wax fractionation process is also used independently of solvent dewaxing to produce high-quality waxes from wax concentrates produced in an independently operated dewaxing unit or from naturally occurring wax concentrates or tank bottoms.

High Quality Waxes

The process is capable of producing crystalline waxes which consistently show oil contents by A.S.T.M. analysis that are below 0.5 per cent. Depending upon the source of the raw waxy concentrate, finished microcrystalline waxes can be produced which, without additives of any kind, have melting points as high as 200° F. and asphalt penetrations at 77° F. as low as 1.0

The process is licensed by Texaco Development Corp.



THE Hypersorption process separates gaseous mixtures by adsorption. The process is capable of effecting separations and recoveries which were previously considered uneconomical. Separation is accomplished with a moving body of activated carbon granules which is temperature controlled to provide the desired temperature gradient for a specific operation.

Continuous Process

The process depends on the ability of activated carbon to adsorb heavier gases or larger molecules to a greater degree than lighter gases or smaller molecules. The process is completely continuous.

Temperature gradient in the moving body of activated carbon is achieved through the use of cooling and heating sections at the top and bottom of the column, respectively. The feed mixture enters the column and passes up through the downward moving body of activated carbon. The heavier molecules are adsorbed and the lighter molecules pass out of the column as top product gas.

Side Products

The heavier molecules, adsorbed on the carbon, pass down through the column until they are stripped from the carbon in the heating zone at the bottom of the column, allowing their removal as bottom product. This stripping causes part of the heavier molecules to flow upward in the descending carbon bed. A refluxing action is thus established which results in a sharper separation of the lighter and heavier molecules. Side products of intermediate composition can be withdrawn at suitable points between top and bottom product offtakes. The stripped carbon, leaving the bottom of the column, is conveyed to the top of the column, thus completing the cycle.

Typical results obtained in extracting ethylene from cracking unit gases are given in the accompanying table.

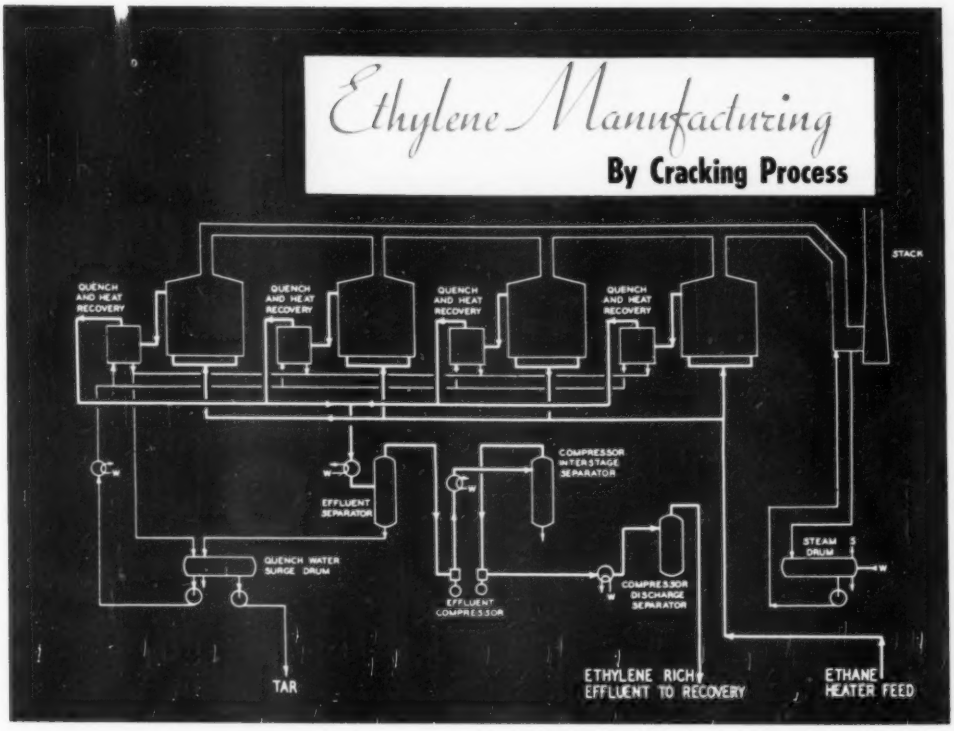
COMPOSITION IN PER CENT BY VOLUME

	Feed	Top product	Side cut	Bottom product
H_2	22.8	47.0		
CH_4	32.6	57.1	0.1	
C_2H_2	1.1		3.6	
C_2H_4	34.0	0.1	90.9	
C_2H_6	2.1		5.6	} 0.2
C_3H_6	0.2			3.4
C_3H_8	5.3		} 0.2	92.8
C_4H_8	0.1			1.8
C_5^+	0.1			
CO	1.5	2.6		
CO_2	0.2	0.2	0.2	

General construction of a typical Hypersorber resembles that of a fractionating column except that the Hypersorber is provided with accessory equipment for storing and transferring the solid adsorbent. Construction of a unit is varied generally according to the processing conditions involved. Multiple feed trays increase the unit's capacity approximately in ratio to the number of such trays.

Discussion on this process, an invention by Union Oil Co. of California, was supplied by Foster Wheeler Corp., New York.

Ethylene Manufacturing
By Cracking Process



ETHYLENE plays a prominent role in the petroleum-chemicals field. It is not found in crude petroleum or natural gas, but it is contained in the "off" gas from refineries cracking petroleum stocks. Where the supply from this source is inadequate or not economically recoverable, it becomes necessary to selectively crack gaseous or liquid petroleum fractions specifically for ethylene production. Most ethylene-producing petroleum-chemical plants use ethane or propane or a mixture of the two as cracking charge.

In this process the ethane-propane feed is charged to the cracking heater where its temperature is raised to 1,460° F. The heater effluent is shock quenched to 1,100° F. by water spray and is further cooled in quench pots by a circulating water stream. The effluent from the quench pots is further cooled by water in shell-and-tube exchangers and then compressed. Polymer and aromatic heavy distillate are condensed in the quench pots and are decanted in the quench-water surge drum. Steam is generated from waste heat in the stack gas.

Heater Design Important

Heaters for a plant of this type are designed to give high temperatures and low residence times required for the desired conversion without causing overheating of the tubes or conditions leading to coke deposition in the tubes.

Ethylene Purification

The separation of refinery gases for the recovery of ethylene can be carried out by either chemical or physical means.

Chemical

For production of alcohol, separation is made chemically by treating the ethylene-rich gas directly with 100 per cent sulfuric acid. In this process, the raw gas requires no pretreatment except the removal of hydrocarbons heavier than ethane, and thus eliminates the difficult ethylene-ethane separation.

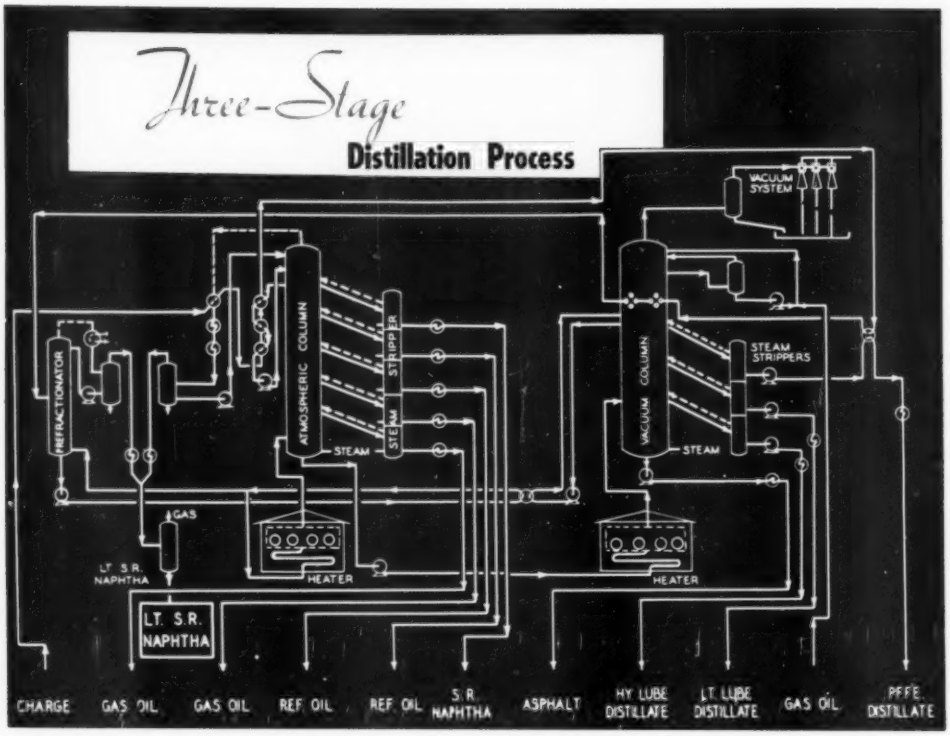
Certain syntheses such as styrene and polyethylene plastics require a high-purity ethylene feed stock. Various methods are employed for obtaining the desired purity.

Mechanical

In purification by fractionation the feed, refinery off gas or effluent from ethane-propane cracking, contains fixed gases, ethylene, ethane, propylene, propane, and heavier hydrocarbons. Water cooled and partially condensed by refrigeration, the feed is charged to a fractionating absorber where the off gas is rejected overhead while ethylene and heavier hydrocarbons are absorbed in the lean oil. Hydrocarbons through C_4 are stripper-separated from the fat oil. A lean oil slip-stream is aromatic distillate product. The stripper overhead is dried with a solid desiccant and charged to the ethylene tower and deethanizer in series.

Water-vapor dew point of the absorber charge is reduced to less than —40° F. to reduce formation of ice and hydrates over extended periods of operation. Duty imposed on the refrigeration system is relatively low since temperatures are in the range of 0° F. and upward.

Discussion on this process was supplied by Lummus Co., New York.



THE first step in the three-stage distillation process shown in the accompanying diagram is prefractionation of the crude-oil charge. After being heated via exchange in the atmospheric and vacuum sections, the other two steps in the process, the charge enters the prefractionator column. Here water and hydrogen sulfide when present in the crude oil charge flashes off at relatively low temperature. This arrangement centralizes low-temperature sulfur corrosion in one small section of the entire unit. This scheme of flashing off water in the prefabrication step along with lighter fractions from the crude oil allows higher top-tower temperatures in the atmospheric column.

Produces Lube Oil Stocks

Products down to light gas oil are removed from the prefractionated crude oil in the atmospheric section of the process. To avoid thermal degradation in the remaining portion of the crude oil for production of high-quality lubricating stocks, the reduced crude from the atmospheric column is processed in the third section of the process. This section incorporates vacuum distillation whereby the various grades of lubricating-oil stocks available in the particular crude oil may be separated.

Two Fired Heaters

Two fired heaters, one for heating the prefractionated crude oil going to the atmospheric column and the other for supplying heat to the reduced crude-oil feed to the vacuum column, are required in the process. These two heaters supply the only heat needed in the operation. A substantial part of the heat entering into the feed stream to the atmospheric fractionator and into the vacuum fractionator feed is obtained by exchange with various other streams in the process.

Overhead product from the prefractionator column is light naphtha which is combined with the overhead from the atmospheric fractionator. This straightrun product is run to storage for further processing.

Yields from Atmospheric Fractionator

The atmospheric section of the process yields a heavy naphtha as its first side cut. This product is steam stripped, cooled, and run to storage. The next atmospheric fractionator side stream is a light burning oil as is the next or third side stream. These streams are also steam stripped, cooled, and sent to storage. The next two side cuts are respectively light and heavy gas oils. Both of these streams are treated in a similar manner as the other side cuts before they are run to storage.

Products from Vacuum Column

Yields from the vacuum column include generally gas oil, paraffin distillate, and light and heavy lube distillates. Each of these products with the exception of gas oil is steam stripped after leaving the vacuum column. The residual oil, vacuum-tower bottom product, is cooled and sent to storage.

This description of three-stage distillation is based on the general scheme of the process. Discussion is from material supplied by Foster Wheeler Corp., New York.

FURFURAL REFINES GAS OIL

THE NEW 8,000-BBL. UNIT AT EAGLE POINT REFINERY GOES ON STREAM

by H. H. Gross, W. E. Skelton, and J. C. Best

THE first commercial furfural refining unit designed primarily for extracting catalytic cycle gas oils for production of high-quality diesel and domestic heating fuels has been placed in operation by The Texas Co. at its Eagle Point, N. J., refinery. The design of this unit resulted from careful study of data developed in laboratory and pilot-unit work as well as experience gained from approximately 2 years' operation of a semi-commercial plant in which as many as 2,500 bbl. per day of various gas oils were satisfactorily extracted with furfural.

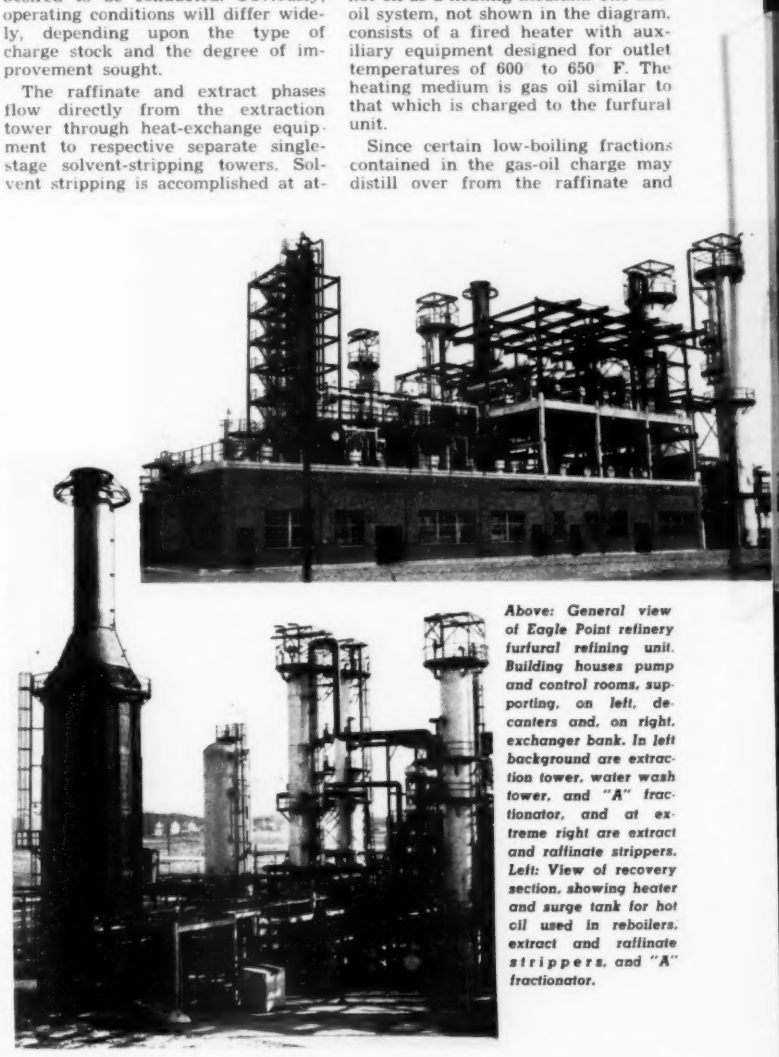
Demand for virgin gas oils for high-speed diesel fuel, domestic heating fuel, and catalytic cracking charge stock has exceeded supply and thus presented a problem which is further complicated by the increasing production of and the necessity for utilizing high-sulfur crude oils. This problem may be solved to a considerable extent by the upgrading of catalytic cycle stock. To meet this situation, The Texas Co. installed a furfural refining unit at Eagle Point refinery, where catalytically cracked cycle gas oil is extracted with furfural to effect an improvement in cetane number and burning quality, as well as a reduction in sulfur content.

The flow through the Eagle Point unit is shown in the schematic diagram, Fig. 1. This unit embodies a simplified countercurrent extraction or treating tower, product strippers, and solvent-recovery equipment. The unit is designed to operate on a variety of gas oils differing widely in boiling range. Gas oils above 325° F. initial true boiling point can be satisfactorily processed. Certain equipment such as the decantation system and water wash tower would not be required with gas oils having initial boiling points above 360° F. t.b.p.

A solvent dosage of not more than equal volume of the charge oil is employed at extraction temperatures in the range of 90° to 125° F. Control of selectivity is also obtained by addition of small amounts of water to the solvent. Flexible design of the solvent recovery equipment permits the return of either water wet or dry solvent to the extraction tower. The use of "wet" solvent is particularly advantageous in case the temperature of the cooling water limits the minimum extraction tower bottom temperature at which the extraction is desired to be conducted. Obviously, operating conditions will differ widely, depending upon the type of charge stock and the degree of improvement sought.

The raffinate and extract phases flow directly from the extraction tower through heat-exchange equipment to respective separate single-stage solvent-stripping towers. Solvent stripping is accomplished at atmospheric pressure by the injection of live steam into each stripper, where suitable temperatures are maintained by reboilers employing hot oil as a heating medium. The hot-oil system, not shown in the diagram, consists of a fired heater with auxiliary equipment designed for outlet temperatures of 600° to 650° F. The heating medium is gas oil similar to that which is charged to the furfural unit.

Since certain low-boiling fractions contained in the gas-oil charge may distill over from the raffinate and



Above: General view of Eagle Point refinery furfural refining unit. Building houses pump and control rooms, supporting, on left, decanters and, on right, exchanger bank. In left background are extraction tower, water wash tower, and "A" fractionator, and at extreme right are extract and raffinate strippers. Left: View of recovery section, showing heater and surge tank for hot oil used in reboilers, extract and raffinate strippers, and "A" fractionator.

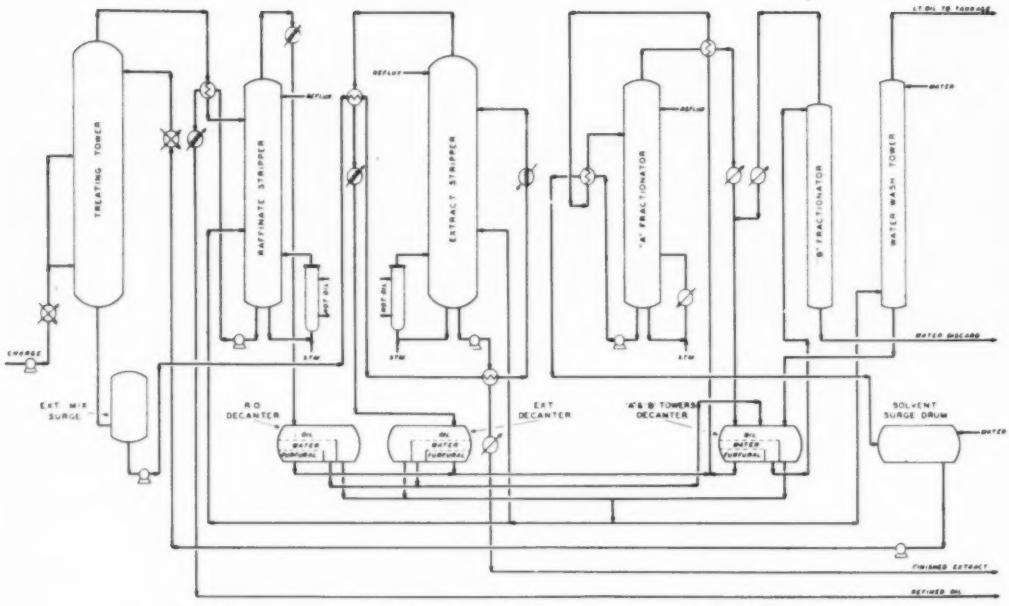


Fig. 1—Schematic flow diagram of furfural refining unit at the Texas Co.'s Eagle Point refinery.

extract stripping towers along with furfural which has a boiling point of 323° F. at atmospheric pressure, facilities are provided to handle any such "light" oil which may come overhead from the strippers.

The overhead condensates from both strippers flow to respective raffinate and extract decanters at temperatures of approximately 100° F. and there separate into three immiscible phases. Each phase contains oil, water, and furfural. The oil-rich phase contains approximately 5 per cent furfural, and its volume depends, of course, upon the amounts of the low-boiling-point fractions contained in the gas-oil charge stock, as well as on operating conditions employed. Depending upon the quality and quantity of the light-oil phase, it may be recycled to the extraction tower, returned to either the raffinate or extract stripper, or charged to a water-washing tower for the recovery of furfural.

The middle or water-rich layer is pumped to a third decanter from which it may be pumped to the water removal tower ("B" fractionator) or be used as reflux on the product strippers. The lowest or furfural-rich layer is pumped through heat exchangers to the "A" fractionator for dehydration and the removal of miscible light oil as illustrated in the flow diagram. The recovered furfural generally contains some dissolved light oil, the percentage depending upon the decanter temperatures and the solubility of the oil in furfural. The presence of light oil in the recovered furfural presents no operating problem with a unit of this design, although it does necessitate the circulation of additional furfural. For reasons of economy, the concentration of oil in the furfural charged to the extraction tower will be maintained as low as possible.

In addition to receiving the water phase from the two stripper decanters, the third decanter also receives the condensates from the "A" and "B" fractionators and the water-

TABLE 2—FURFURAL REFINING GAS OILS—CETANE NUMBER IMPROVEMENT

Crude source—	Cracked stock—California			
	Charge	Raffinate	Charge	Raffinate
Yield, volume per cent	100.0	83.6	72.7	63.6
Cetane No.	38.4	45.3	52.1	57.7
Gravity, °A.P.I.	28.6	32.0	35.4	38.1
Color, N.P.A.	3½	2—	1½—	1½—
Distillation, A.S.T.M.:				
I.b.p., °F.	461	477	478	479
10 per cent	495	439	499	496
50 per cent	530	530	531	532
90 per cent	580	581	582	586
End point	622	623	616	623

TABLE 1—FURFURAL REFINING GAS OILS—CETANE NUMBER IMPROVEMENT

Crude source—	Virgin stocks						Cracked Stocks					
	Venezuela		California		West Texas		Arabian		Venezuela		California	
	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate
Yield, volume per cent	100	66.6	100	95.0	100	82.0	100	60.0	100	60.5	100	65.5
Cetane No.	34.4	49.6	46.2	50.6	53.2	62.9	19.0	61.0	33.6	53.0	37.7	55.1
Gravity, °A.P.I.	24.2	30.8	28.9	30.6	33.9	37.8	20.2	40.4	24.5	33.6	29.7	38.8
Color, N.P.A.	7	3+					2½—	1½—	7	1—		
Sulfur, weight per cent	0.80	0.37	0.98	0.72	1.12	0.49	1.705	0.451	0.58	0.09	0.50	0.06
Distillation, A.S.T.M.:												
I.b.p., °F.	430	462	416	412	374	390	454	454	418	452	436	416
10 per cent	478	502	466	470	492	492	488	490	457	477	470	458
50 per cent	572	584	584	593	560	560	521	530	543	561	510	506
90 per cent	695	710	746	754	598	596	586	590	652	666	580	580
End point	734	752			618	620	642	634	716	718	646	638

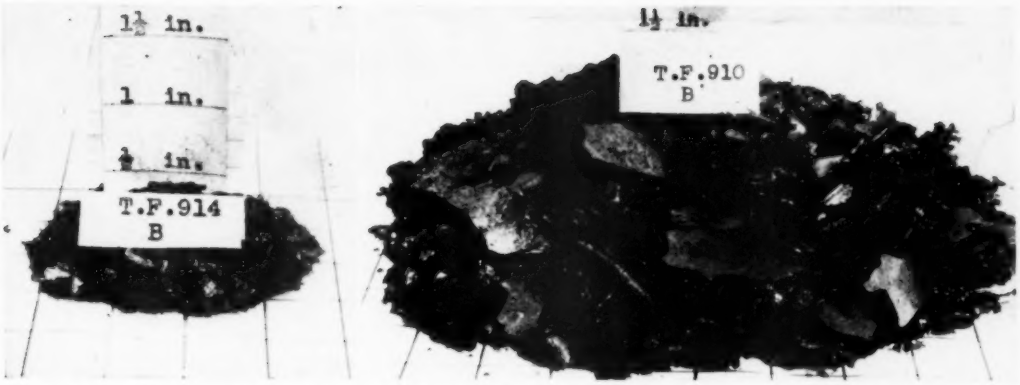


Fig. 2—Cut at left shows pot-type burner bottom deposit of furfural refined catalytic gas oil. View at right shows domestic burning test of pot-type burner bottom product.

furfural effluent from the water-wash tower when same is being operated. Here phase separation permits disposal of: (1) the oil layer in the manner outlined for the other decanters, (2) the water layer to the "B" fractionator for the recovery of furfural and elimination of water, and (3) the furfural layer to the "A" fractionator for dehydration.

The operation of this commercial unit has been entirely satisfactory and the products have closely duplicated those obtained in previous pilot unit studies refining the same stocks.

Ignition-Quality Improvement

For optimum performance of the high-speed diesel engines in use today, fuels of high ignition quality are essential. Furthermore, it is desirable that the fuels, upon combustion, be satisfactory with respect to smoke, odor, and engine deposits. The data in Tables 1 and 2 illustrate the degree of cetane-number improvement obtained in the furfural refining of virgin gas oils and catalytically cracked cycle stocks derived from various crude sources.

Since the nature of the crude has an influence on the quality of the unrefined stocks, it would be expected that the refining characteristics will differ. This is shown by the data in Table 1 for the Venezuela and West Texas stocks. As a matter of interest, gas oils of approximately the same quality, whether virgin stocks or cracked cycle gas oils derived therefrom, respond equally well to refining, as shown in the case of the Venezuela stocks.

The extent of cetane-number improvement is dependent upon the degree of refining, and is illustrated by the data in Table 2, obtained in the furfural refining of a California catalytically cracked cycle stock.

Diesel fuels of 50 cetane number made in one case from virgin gas oil and in the other case by furfural refining of a catalytic cycle oil were tested in a laboratory single-cylinder General Motors diesel engine operating on an alternate full-load-idle cycle. Examination of the engine after 80 hours' operation on each fuel revealed equally low engine deposits and wear. The power and fuel economy ratings of the fuels tested were equivalent, nor could any difference be observed in odor and smoke tests between the two fuels during the operation. Both fuels were considered satisfactory for good diesel-engine operation.

Since furfural is an excellent solvent for aromatic materials, the extract obtained from the furfural refining of cracked stocks is highly aromatic, reaching as high as 85 per cent. Fractions from the distillation of these extracts will comprise 90 to 95 per cent aromatics. These materials may be useful as solvents of low volatility, raw materials for the

(Continued on page 332)

The Authors

H. H. GROSS

W. E. SKELTON

J. C. BEST

Howard H. Gross, with Texaco Development Corp. in New York City, joined Indian Refining Co. upon completing his education at Penn State College and Missouri School of Mines. He joined The Texas Co., when it acquired Indian, and served in its Beacon, N. Y., laboratories, where he assisted in the development of the furfural refining process. Later he was assigned to the office of director of research.

W. E. Skelton is with the Beacon laboratories of The Texas Co. where he has been engaged in lubricating-oil processing as well as the catalytic operations on fuels. A graduate of Rice Institute, he joined the company at its Houston Works, and was engaged in refinery control work. After resuming graduate work at M.I.T., he was with Texas Pacific Coal & Oil Co. as process engineer and plant engineer. He rejoined The Texas Co. in 1935.

J. C. Best joined the Port Arthur laboratory of The Texas Co. in 1933, following graduation from Rice Institute, and worked on both research and technical service assignments in the manufacture of lubricating oils and associated byproducts. Later he became assistant director of the lubricating-oil department at Port Arthur, and in 1945 was transferred to New York as processing engineer in the refining department of New York managerial division.

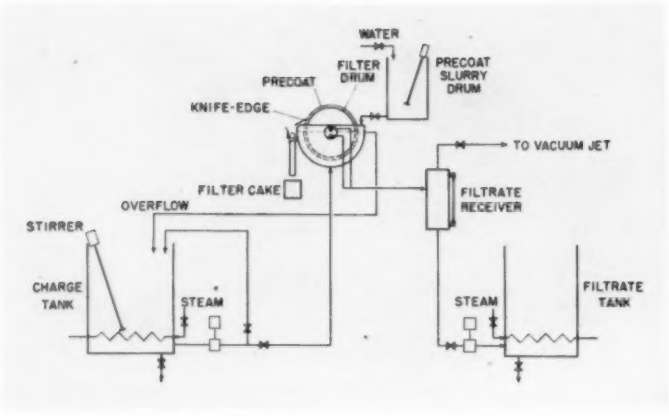


Diagram of pilot filter unit used in slop-oil filtration study.

Pilot Unit Studies on

DISPOSAL of industrial wastes from a large petroleum refinery is in most cases complicated by the fact that the waste-disposal systems were designed to handle liquid wastes from relatively simple process operations such as distillation, doctor sweetening, water washing, thermal cracking, etc. Large plant expansions in recent years and the introduction of new, more complex processes have resulted in increasing the load on the waste-disposal systems, and the necessity for treating wastes of a type different from that for which the systems were originally designed.

The discharge of spent chemicals, emulsions, waste oils, sanitary sewage, finely divided solids, and surface drainage into the gravity-type separators, commonly used for separating oil and water, results in decreasing the effectiveness of these separators, and increases the difficulty of maintaining an effluent water of satisfactory quality. Oils and emulsions recovered from the separators are heavily contaminated with finely divided solid particles that are very effective in stabilizing the emulsions. The recovered oils require treatment to free them of sediment and water prior to redistillation. The chemical treatment of the recovered oils and emulsions with various treating agents results in the recovery of most of the oil; however, this treatment in many cases produces a considerable volume of more stable interfacial emulsion which in itself presents a disposal problem.

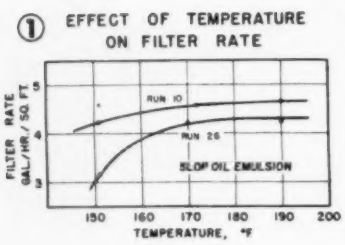
Purpose of Investigation

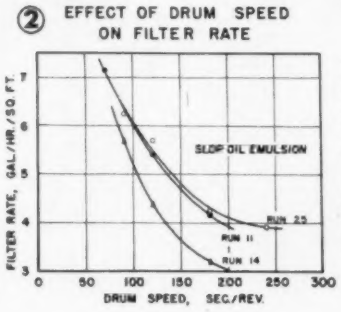
Because of the unsatisfactory results obtained in the chemical treatment of refinery emulsions, the investigation described herein was made to evaluate the continuous precoat filtration process as a means of resolving refinery emulsions recovered from separators, upgrading the quality of the recovered oil, and improving the quality of the effluent water discharged from the Baytown refinery of Humble Oil & Refining Co. It was also desired to develop operating data necessary for the design of a plant-scale waste oil emulsion filtration system and for estimating operating costs.

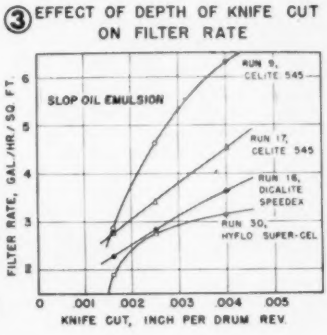
In another phase of this work a laboratory study was made of the filtration characteristics of sludge which settles out in the gravity-type oil-water separators.

During past years, accumulation of bottom sediment in the gravity-type separators has necessitated frequent cleaning of the separator bottoms by dredge or drag line. It has been necessary to provide and maintain large earthen pits for the accumulation of the dredgings. These pits are unsightly, present a potential spillage hazard, and make useless for any other purpose the land which they occupy. Further, the separators operate for a large part of the time at considerably less than their maximum efficiency because of the reduced effective volume and retention time resulting from the accumulation of sediment.

A project currently in progress for the improvement of waste-disposal facilities and quality of the refinery effluent is the modernization of the main separator. Since this project includes the installation of traveling skimmers and scrapers for the continuous removal of surface oil and bottom sediment, it would be desirable to provide a means of handling the bottom sediment stream so that a relatively dry material will be obtained, and thus eliminate the need






③ EFFECT OF DEPTH OF KNIFE CUT ON FILTER RATE
FILTER RATE, GAL/HR/SQ FT
SLOP OIL EMULSION
RUN 9, CELITE 545
RUN 17, CELITE 545
RUN 16, DICALITE SPEEDEX
RUN 30, HYFLO SUPER-CEL
0 .001 .002 .003 .004 .005
KNIFE CUT, INCH PER DRUM REV.

FILTRATION OF REFINERY EMULSIONS AND SEPARATOR SEDIMENT

by E. Q. Camp* and Cecil Phillips*

for additional earthen storage pits for storing the separator dredgings.

The material to be disposed of is a complex mixture of finely divided, oil-coated, solid particles in a water slurry. The solids consist of silt, clay, carbon, shell dust, catalyst, metallic sulfides and hydroxides, insoluble organic precipitates, sludge from water-treating plants, and sanitary sewage.

The laboratory study of the filtration characteristics of sludge taken from the bottom of the main separator was made on a small commercial precoat filter having a drum 2 in. wide and 12 in. in diameter, while the studies on emulsion filtration were made on a similar filter with a drum 12 in. wide and 12 in. in diameter. The results obtained on precoat filtration of these two materials will be discussed separately.

Filtration of Waste-Oil Emulsions

Various mixtures of refinery slop oils produced at Baytown were filtered under various operating conditions through the small-scale vacuum filter using several types of diatomaceous-earth precoat materials. The charge to the filter consisted of various mixtures of the following types of emulsions, (1) crude tank bottoms, (2) thermal cracking coil slop oil, and (3) slop oil skimmings recovered from gravity-type separators in the refinery. In general, these emulsions were of the water-in-oil type containing a large amount of finely divided solid particles which contributed materially to the stable characteristics of the emulsion.

Earlier laboratory filtration tests using small filter leaves had shown that solids in the emulsions were of such a size and character that plugging of ordinary filter media occurred very rapidly, and that it would be necessary to use filtration equipment having a very short filtration cycle, such as a drum-type continuous precoat filter. These filter-leaf tests also indicated that filtration of the emulsions for the removal of solids would result in complete resolution of the emulsions, producing clear water and oil phases which would not form stable emulsions on subsequent violent agitation. The effectiveness of the filtration process in resolving these emulsions is probably due to the rupturing of the oil and water globules on passing through the filter medium, allowing these particles to coalesce into separate phases. The stabilizing influence of the finely divided solid particles is removed by filtration.

On opposite page is diagram of pilot filter unit and auxiliary equipment used in this study. During the precoating operation the precoat slurry drum was filled with approximately 40 gal. of water and the precoat medium was added to the water. Throughout the precoating operation the slurry was agitated vigorously by an air-driven stirrer. The slurry concentration during precoating varied from about 0.3 to 1.0 per cent by weight. It was found that serious cracking of the precoat developed during the filtering period when the precoat slurry concentration was allowed to go above 2 per cent.

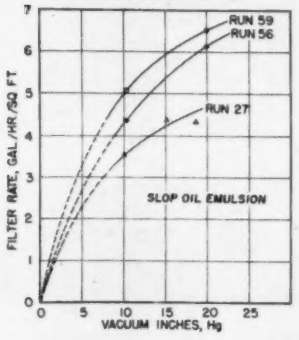
During the latter part of this study, several filtration runs were made using precoats deposited from oil slurries. One attempt in which slop oil filtrate was used as the precoating slurry medium was unsuccessful because of plugging of the precoat layer with black tarry material after only a thin layer of the precoat medium had been deposited on the screen. Precoats were successfully deposited with gas oil as the slurry medium at 170° F. The oil-deposited precoats appeared to have essentially the same filtering characteristics as the water-deposited precoats.

During filtration the mixed emulsion was pumped into the filter tank at a rate greater than the total filter capacity, and the excess overflowed from the filter tank into the charge tank. This procedure was necessary to maintain a constant temperature and

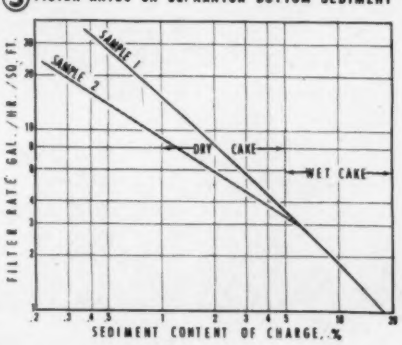
(Continued on page 341)

*Humble Oil & Refining Co., Baytown, Tex.

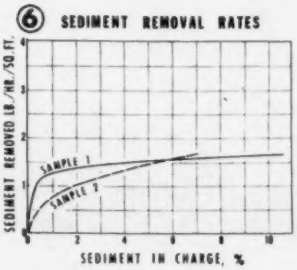
④ EFFECT OF PRESSURE DROP ON FILTER RATE



⑤ FILTER RATES ON SEPARATOR BOTTOM SEDIMENT



⑥ SEDIMENT REMOVAL RATES



PROPANE Deasphalting

. . . . AT UTAH OIL REFINING CO.

by C. W. Nysewander and L. V. Durland

UTAH OIL REFINING CO. at Salt Lake City placed its new 10,500-bbl. per stream day propane deasphalting unit* on stream in March 1949. This culminated an investigation, which was started shortly after World War II, to select a method for processing reduced crude to make a gas oil suitable for catalytic cracking charge and an asphalt for blending into road oil or residual fuel. High gasoline budgets, after the war, requiring high crude runs found the company short in crude running and

*"JUIX" type process licensed under the patent rights of Standard Oil Co. (N. J.), Union Oil Co. of California, Standard Oil Co. (Ind.), and M. W. Kellogg Co.

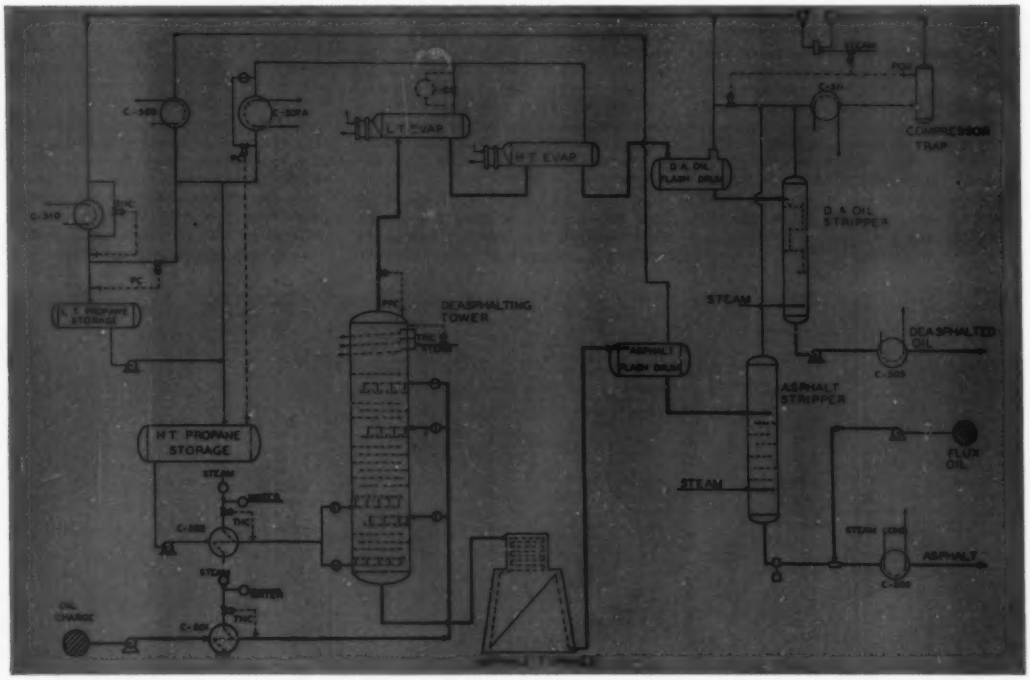
C. NYSEWANDER

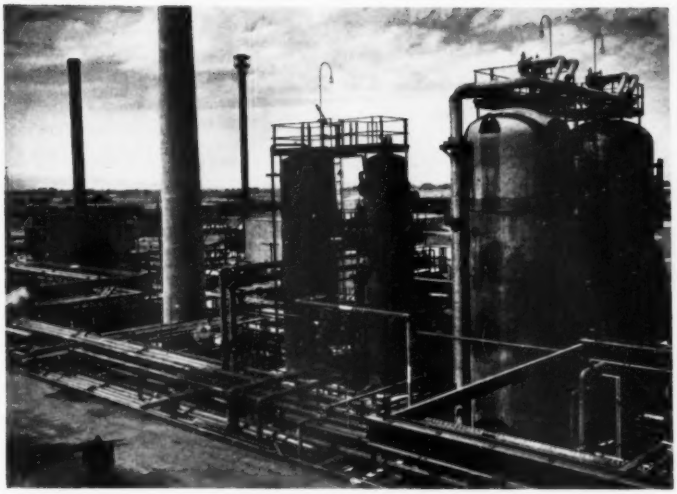
L. V. DURLAND

Cecil W. Nysewander became a member of the research department of Utah Oil Refining Co. in 1943. Prior to that time he had spent 12 years in research and development work for the Standard Oil Co. (Ind.). A Hoosier by birth, he has a B.S. degree from University of Illinois (1930) and an M.S. degree from California Institute of Technology, both degrees in chemical engineering. Currently he is group leader in charge of light oils technical service.

Laurence V. Durland joined the Utah's research department in 1944. Previously he, too, was employed in the research department of Indiana Standard. He is a native of Montana and a graduate of Montana State College where he received a bachelor of science degree in chemical engineering.

Fig. 1—Simplified flow diagram of Utah Oil Refining Co.'s propane deasphalting unit.





Utah Oil Refining Co.'s propane deasphalting unit. Furnace at left, asphalt and deasphalting strippers in center, and the deasphalting towers in right foreground. Flare stack in background is for closed relief-valve system.

in reduced crude-processing equipment.

An uncertain market for residual fuels provided an incentive for installing equipment to process reduced crude and permit the minimum production of heavy fuel for sale. Propane deasphalting was chosen because of its favorable payoff, low yield of residual fuel, quality of asphaltic products, and flexibility and simplicity of operation. A simplified flow diagram of the propane deasphalting unit, including only one deasphalting tower for simplicity, is shown in Fig. 1.

Contactors of the unit are two towers 11 ft. in diameter by 40 ft. high with each tower containing 18 baffles. Three sets of steam coils in the top of each tower provide a source of heat for temperature-gradient operation. Reduced crude is pumped from storage through an exchanger and introduced into the towers above the second baffle from the top. Alternate feed points are provided above the sixth and fourteenth baffles. Propane is pumped from the high-temperature storage through an exchanger and introduced below the eighteenth tray. An alternate feed point for the propane is located below the thirteenth tray. Sufficient pressure is maintained on the tower to assure a liquid to liquid contact.

The overhead stream from each of the towers, consisting of deasphalted oil and propane, passes through a low-temperature evaporator followed by a high-temperature evaporator to remove propane. The liquid streams from the two parallel high-temperature separators are combined into a flash drum. The deasphalted oil, with perhaps a trace of propane, flows from the flash drum into a stripper from which the propane-free oil is pumped through a cooler to storage.

The deasphalting-tower bottom streams are combined and pressured directly to the furnace where the asphalt plus propane is heated to about 525° F. before entering the flash drum. The flashed asphalt is stripped free of propane in the steam stripper and is then pumped to an exchanger where flux oil is added to produce a final product of desired viscosity.

The propane from the high-pressure vessels, i.e., the deasphalted oil evaporators and the asphalt flash drum, is condensed and stored in the high-temperature propane storage drum. The propane vapors from the strippers go through a surface condenser and are compressed. The compressor discharge and the deasphalted oil flash drum vapors are condensed

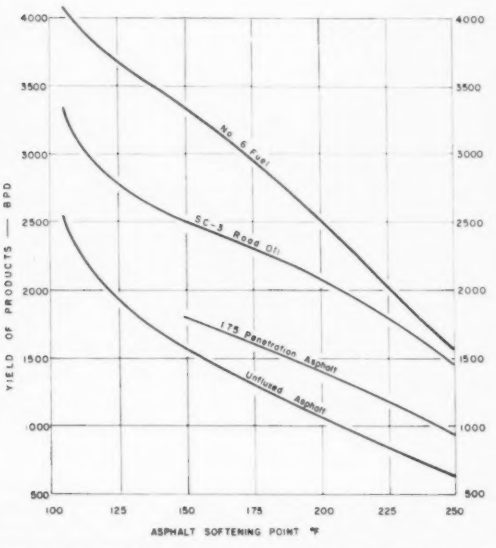
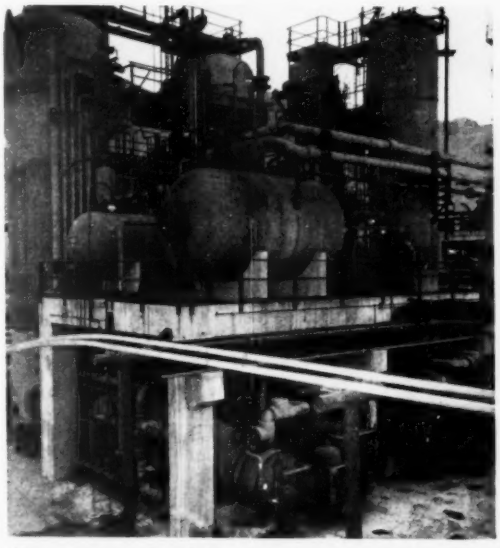


Fig. 2—Product yields from propane deasphalting vs. asphalt softening point. (Basis 10,500 bbl. per day of 47 per cent residuum.)



View of propane deasphalting unit showing deasphalted oil and asphalt flash drums. In lower foreground are deasphalted oil evaporators.

and stored in the low-temperature propane storage. Propane is then pumped from the low-temperature storage to maintain a level in the high-temperature storage drum.

The unit was designed for two different sets of conditions to provide considerable flexibility in operation. The first set of design conditions, referred to as Case I (see Table 1), was established for the production of a relatively hard asphalt. This operation represents the minimum operating temperatures for the deasphalting towers, 160 F. top temperature and 150 F. bottom temperature. The conditions for this operation set the size of the equipment for recovering the deasphalted oil. The second set of design conditions, referred to as Case 2 (see table), was established for the production of a soft asphalt. The operating conditions for Case 2 represent pilot-plant operations on a 32 per cent reduced crude to produce a soft asphalt (150 penetration or 110 F. softening point). The deasphalting towers, however, have been designed for a maximum temperature 5 F. higher (195 F.) than required for Case 2 operation. The conditions for this operation were used for sizing the asphalt-recovery equipment.

The design operating conditions and yields were established by pilot-plant work. Experience at Utah indicates that it is extremely desirable to obtain pilot-plant data on the precise charging stock that is to be used in the plant. In some important respects the operating conditions for the Utah contacting towers differ quite markedly from conditions that would have been predicted from data, available at the time the plant was initially considered, on reduced crudes other than Rangely. The rather detailed pilot-plant program in which reduced Rangely crude was deasphalted on a tower-type contactor proved to be a very worth-while investment both in the economic evaluation of the process as well as in the actual design of the plant.

Initial Operations

Operation of the unit was started on March 11, 1949. Several shutdowns because of mechanical difficulties were made before the unit was put on stream with both towers in operation on March 29. The feed rate was set at 10,500 bbl. per day and operating conditions were adjusted to produce an amount of deasphalted oil and an asphalt quality comparable with design Case 1. The operations were held constant for a sufficient length of time to observe the mechanical performance of the unit at the design production of deasphalted oil. After satisfactory performance under these conditions, changes in operation were made to test the design capacity of the asphalt-recovery system (Case 2 operation).

The operating conditions and yields for these two tests are tabulated in Table 1 for comparison with the design data and with the anticipated operating conditions. A temperature gradient in the deasphalting towers was not used for the Case I operation. During the startup operations, constant-temperature conditions had been employed because of simpler control and it was believed that the effect of temperature gradient could be better studied after gaining more experience in operating the unit.

Theoretically the Conradson carbon of the deasphalted oil would be improved under temperature-gradient operation. The Case 1 operation required a higher temperature and resulted in a higher yield of asphalt than design. The conditions of the test were held as shown since any decrease in temperature would have resulted in a somewhat harder asphalt.

The second capacity test was made by adjusting operating conditions to duplicate as early as possible the yield and quality of the asphalt predicted in design Case 2. It is evident in Table 1 that the asphalt production was sufficient to test the capacity of the recovery system. The deasphalting tower temperatures were somewhat lower than design and the separation as evidenced by the oil Conradson carbon appears to be in line.

It is the practice at Utah to characterize the deasphalting unit charge in terms of Rangely reduced crude. The degree of reduction is determined from the viscosity of the charge as compared with viscosity of Rangely crude residua. The Rangely crude received at the refinery contains some Iles crude which is quite similar in nature. In addition Wilson Creek crude, a paraffin-base crude, is run in the refinery and the bottoms go to deasphalting charge. It has become quite evident that an unchanging charge stock is highly essential to smooth operation of the deasphalting unit.

The initial operations of the Utah deasphalting unit were on a 32 per cent reduced crude, for which it was designed, but the charge gradually changed and leveled out at approximately a 50 per cent reduced crude. Operations will be on a 50 per cent reduced crude for some time due to limitations of the refinery crude-fractionating equipment.

Current operations on a 50 per cent reduced crude indicate separations as good or better than predicted by pilot-plant data. Initial operation of the unit on the 32 per cent reduced crude indicated poorer separations of asphalt and deasphalted oil than expected. The time during which this charge stock was run was not long enough to procure conclusive data. However, it is believed that more plant experience with this stock would have resulted in a marked improvement in the separation. Most of Utah's experience has been with the light (approximately 50 per cent) reduced crude.

Deasphalting temperatures lower than predicted by pilot-plant correlations have resulted in greatly increased flexibility when processing the 50 per cent reduced crude. The design propane ratio is 5:1 and an increase to 6:1 effected a marked decrease in Conradson carbon. The propane used for deasphalting contains from 40 to 60 per cent propylene. This olefin content has not shown any deleterious effect.

The unit has proved very flexible in operation. The feed rate to one tower has been as high as 115 per cent and as low as 50 per cent of design. Asphalts have been produced with softening points over the range

(Continued on page 290)

TABLE 1—CAPACITY PERFORMANCE TESTS

Type of operation →	Case 1		Case 2	
Test date—	Mar. 31, 1949	Design	Apr. 1, 1949	Design
Feed rate, bbl. per day	10,500	10,500	10,500	10,500
Deasphalted oil, bbl. per day	8,560	9,030	6,720	7,035
Asphalt, bbl. per day	1,940	1,470	3,780	3,465
Propane-to-oil ratio	5:1	5:1	5:1	5:1
Feed stock:				
Gravity, A.P.I.	16.7	17.8	17.8	17.8
Viscosity, S.S.F. 140 F.	87	85	72	85
Conradson carbon, weight per cent	9.11	8.8	8.02	8.8
Estimated per cent on crude	31.8	32.0	33.5	32.0
Deasphalted oil:				
Yield:				
Volume per cent on charge	81.5	86.0	64.0	67.0
Volume per cent on crude	25.9	27.5	21.4	21.4
Gravity, A.P.I.	24.3	22.5	24.8	24.5
Conradson carbon, weight per cent	2.32	1.7-1.9	1.74	1.4-1.6
Asphalt:				
Yield:				
Volume per cent on charge	18.5	14.0	36.0	33.0
Volume per cent on crude	5.9	4.5	12.1	10.6
Softening point, F.	175	164	104	112
Operating conditions:				
Temperatures:				
Reduced crude feed, F.	174	206	198	190
Propane feed, F.	164	150	172	190
Tower top, F.	170	160	183	190
Tower bottom, F.	170	150	183	190
Tower pressure, psig.	550	450	605	605

HORTON* DOUBLE-DECK FLOATING ROOFS

the more *they* work ...the more *you* save

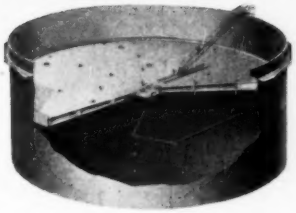
Suppose you are using a cone-roof tank. "Filling" evaporation losses occur because the incoming liquid displaces vapor. There are large "breathing" losses too. When the temperature rises, the air-vapor mixture in the tank expands and vapor escapes through the vents in the roof of the tank.

Now consider a tank equipped with a Horton Double-Deck Floating Roof. There is no vapor space between the liquid in the tank and the roof because this roof floats directly on the liquid. Eliminating the vapor space stops both "filling" and "breathing" losses. Furthermore, the air space between the decks of the floating roof provides insulation which reduces the temperature of the stored liquid, making it possible to store more volatile liquids without boiling losses.

WANT PROOF of how this saves? Examine the data at the right. In making these estimates, it was assumed that the tanks would be filled 6 times per year with motor gasoline valued at $4.62 per 42 U.S. gallon bbl. The annual cost of using a cone-roof tank is 19.95 cents per bbl. or more than double the storage cost using a Horton Floating Roof.

For more details write the nearest office listed below.

Above: 96,000-bbl. tank with a Horton Double-Deck Floating Roof at Sinclair Refining Co., East Chicago, Ind., refinery.



Cutaway view showing construction of Horton Double-Deck Floating Roof in a butt-welded tank.

Annual Storage Cost Comparison

1) Tank with Horton Double-Deck Floating Roof
Initial Cost—$64,800 (80,000-bbl. tank)

Depreciation 10% of 64,800 =	$6,480
Standing loss 180 bbls. x 4.62 =	832
Total ANNUAL Storage Cost =	$7,312

ANNUAL cost per bbl. $= \frac{7,312}{80,000} = 9.14$ cents

(Note there are no filling losses)

2) Cone Roof Tank
Initial Cost—$47,800 (80,000-bbl. tank)

Depreciation—10% of $47,800 =	$4,780
Filling Losses—720 bbls. x 4.62 =	3,326
Breathing Losses—1700 bbls. x 4.62 =	7,854
Total ANNUAL Storage Cost =	$15,960

ANNUAL cost per bbl. $= \frac{15,960}{80,000} = 19.95$ cents

*Trademark registered in U. S. Patent Office.

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Fluid Catalytic Cracking of High-Sulfur Stocks with Natural Catalysts....

by E. Jackson Thomas*

SINCE the initial operation of Gulf Oil Corp.'s fluid catalytic cracking unit located at its Philadelphia refinery, the quantity and sulfur content of the charge stocks have steadily increased. A comparison between typical initial, and current charge stocks and rates is given in Table 1. Except for the second run during which silica alumina synthetic catalyst was used, the unit has always been operated on natural catalysts.

It has been generally felt that high-sulfur gas oils could not be successfully cracked over natural catalysts without hydration of the regenerated catalyst. When it appeared that the sulfur content of the charge was gradually increasing as compared with the type of stock initially charged, it was decided to provide means for hydrating the catalyst by injecting steam into the regenerated catalyst standpipes. Work by Gulf Research & Development Co. confirmed the belief that steam would suppress the poisoning effect of high-sulfur stocks.

One theory explaining this poisoning action is that the sulfur in the stock, depending to some extent on the type of sulfur linkage involved, activates the iron present in natural catalyst. This activated iron then acts in a similar fashion to other metallic contaminants such as vanadium and nickel in lowering the selectivity of the catalyst, that is increasing the coke and gas make and lowering the gasoline made. The mechanism of hydration is not known, but in some way it probably suppresses the formation of iron sulfide by action of either hydrogen sulfide or organic sulfur in the reaction zone on the iron in the catalyst, which is followed by the oxidation of the iron sulfide to an active iron oxide complex in the regeneration zone.

As originally designed the fluid unit had no provision for introducing large quantities of steam to the regenerated catalyst standpipe. It was believed that approximately 0.4 weight per cent of steam based on circulating catalyst, would be sufficient, which amounts to 10,000 lb. per hour to adequately hydrate the catalyst. During a turnaround of the unit 3-in. pipes perforated with ⅛-in. holes were mounted concentrically in the regenerated catalyst standpipes. Provision was made for metering the steam to these pipes, and provision was also made for introducing air along with the steam in case it was needed for smoother operation. Due to operating difficulties it was impossible to add more than 2,500 to 3,500 lb. per hour of this hydration steam to the unit. When this hydration steam rate was exceeded the increased aeration of the

*Process division, Gulf Oil Corp., Pittsburgh.

TABLE 1—TYPICAL F.C.C. CHARGE STOCKS

	Initial operation	Current operation
Charge, B./S.D.	13,000	26,000
Gravity, °A.P.I.	25.8	24.0
Sulfur, B, per cent	0.92	2.0
Carbon residue, per cent	0.26	0.50
Aniline point, °F.	190.0	181.6
Distillation, 100 mm. corr. to 760:		
Overpoint, °F.	539	560
10 per cent	665	675
50 per cent	752	850
90 per cent	926	980

TABLE 2—ANALYSIS OF REGULAR AND S.R. NATURAL CATALYSTS

	Natural catalyst (per cent)	
	Regular	S.R.
Al_2O_3	15.7	40.9
Fe_2O_3	1.32	0.42
Na_2O	0.10	0.05

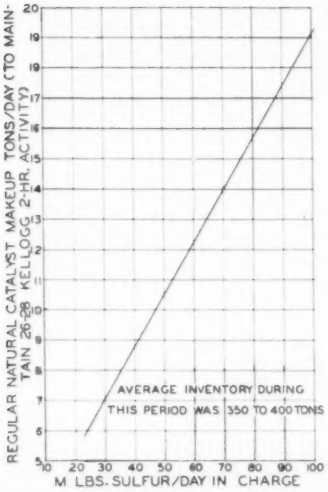
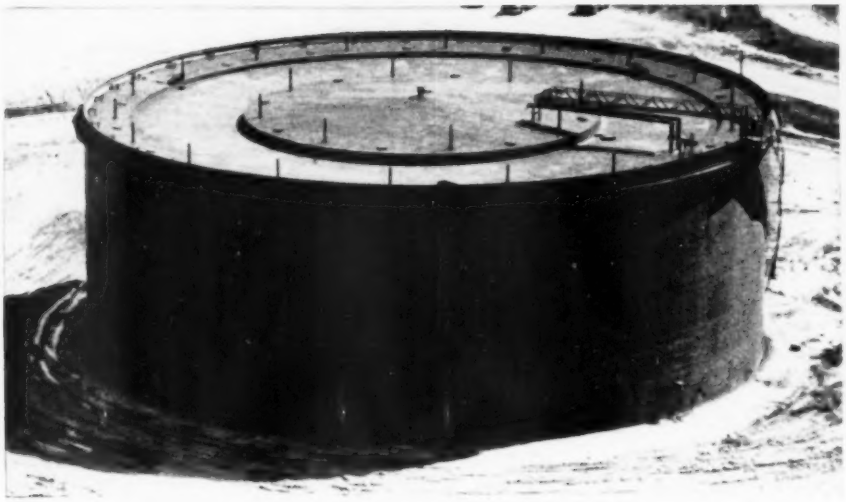

REGULAR NATURAL CATALYST MAKEUP TONS/DAY (TO MAINTAIN 26-28 KELLOGG 2-HR. ACTIVITY)
M LBS. SULFUR/DAY IN CHARGE
AVERAGE INVENTORY DURING THIS PERIOD WAS 350 TO 400 TONS

Fig. 1—Graph showing direct relation between total sulfur in virgin charge and catalyst makeup rate.

TABLE 3—COMPARISON OF TEST METHODS

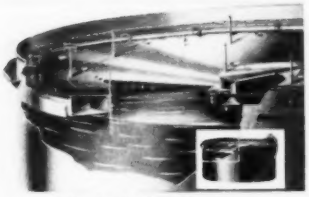
Catalyst—	Volume per cent			Carbon factor	
	Conversion	Gasoline	Gasoline / Conversion	By carbon	By hydrogen
Two-hour test:					
Fresh:					
D	52.3	41.0	0.784	1.34	1.15
S.R.	35.0	30.2	0.862	1.87	1.38
Treated with H_2S, 2 hrs. at 1,000° F.:					
D	44.7	37.0	0.828	1.64	1.47
S.R.	30.8	28.6	0.926	1.78	1.66
Pilot-plant aged:					
D	25.5	24.4	0.956	1.79	1.44
S.R.	26.5	25.8	0.973	1.47	1.37
Pilot-plant aged and treated with H_2S, 2 hrs. at 1,000° F.:					
D	18.4	10.5	0.571	15.93	Off scale
S.R.	23.0	19.1	0.832	3.25	2.90
Thirty-minute test:					
Fresh:					
D	59.6	43.8	0.735	1.17	1.10
S.R.	48.7	33.9	0.697	1.36	1.24
Treated with H_2S, 2 hrs. at 1,000° F.:					
D	64.0	36.5	0.571	1.47	1.61
S.R.	46.5	34.5	0.743	1.38	1.32
Pilot-plant aged:					
D	35.2	29.1	0.827	1.67	1.44
S.R.	40.7	34.1	0.837	1.19	1.36
Pilot-plant aged and treated with H_2S, 2 hrs. at 1,000° F.:					
D	29.7	17.8	0.600	3.84	Off scale
S.R.	35.9	29.5	0.822	1.54	1.42

Exclusive features mean bigger savings

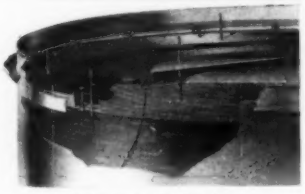


Floats on the liquid and seals the liquid surface with the aid of a vapor-tight closure. Rises and falls with changes in volume. Permits vapors to expand without venting. Prevents losses during refining, transportation and marketing. Saves vapors when unseasonable crudes and products are stored.

Only genuine Wiggins Floating Roofs give you triple seal protection! 75% of "full tank" evaporation losses are eliminated. Retains 50% of the vapors lost by tanks with only single seals. Has the much-copied long limber shoe originated by John H. Wiggins to assure positive, constant contact with the tank shell. Very low maintenance cost—steep deck assures rapid drainage.



Wiggins Hidek Floating Roof



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Wiggins Conservation Structures

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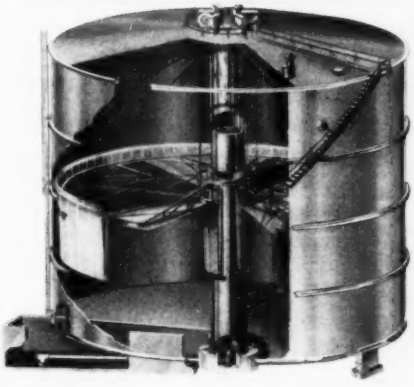
Wiggins Dry Seal Lifter Roof

Turns breathing and pumping losses into profits! The 100% dry seal, which has a life equal to that of the tank, eliminates "wet seal" corrosion problems—requires no heating system during freezing weather. No fire hazard. Has low initial cost—low upkeep. Attention, adjustment or lubrication not needed.

Wiggins
DRY SEAL GASHOLDER
Typical Average Pay-Out
20 MONTHS



Wiggins Dry Seal Gasholder interconnects at standard working pressure with all cone roof tanks for a complete vapor balancing system.

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The economical way to conserve the vapors of a single tank or two interconnected cone roof tanks. The roof is supported by confined vapor, rising and falling as the volume changes. Has a patented dry seal to prevent vapor from escaping. Internal pressure exceeding 1¼" of water causes roof to lift. Maximum roof lift is 10 feet. Balancing system keeps roof level even under eccentric load conditions produced by wind or snow.

. . . by General American

flowing catalyst lowered the differential pressure across the slide valve making control impossible.

The hydration of the catalyst was not completely successful as the natural catalyst-addition rate rose to over 20 tons per day with the high charge rates of high-sulfur stocks. Since the source of the cracking stock had changed it was thought possible that perhaps metallic contaminants in the gas oil might be poisoning the catalyst. However, the 20 tons per day was 5 per cent of the 400-ton working inventory of the unit and the small metallic content of the gas oil as found by laboratory analysis ruled out this possibility and this was further substantiated by metallic analysis of the catalyst.

It is also possible that the form of sulfur in the different charge stock might have been more deleterious to the catalyst than the sulfur in previous stocks. If it is assumed that the total sulfur in the fresh feed to the unit is a measure of the poisonous effect of the charge, then as the pounds of sulfur charged to the unit increases the necessary addition rate of fresh catalyst to maintain the same catalyst activity and selectivity should also increase. Fig. 1 is a plot of the addition rate in tons versus the sulfur charge rate in pounds per day. This plot clearly indicates that fresh-catalyst addition rate was directly dependent on the total sulfur charged to the unit.

Determining Beneficial Effect

To determine whether the hydration steam was having any beneficial effect in suppressing poisoning it was discontinued for a short period, with dispersion and stripping-steam rates maintained at a constant value. The laboratory coke factor jumped from 1.6 to 2.4 and the hydrogen factor increased from 6.2 to 10.4. After 9 days without hydration steam, it was again introduced to the regenerated catalyst standpipes, and within 3 days the catalyst had returned to its previous coke and hydrogen factors given above.

It can be concluded that the hydration steam definitely reduced the poisoning of the natural catalyst by the high-sulfur feed stocks used but not well enough to be satisfactory for economical plant operations. This does not indicate that if enough steam had been used to hydrate adequately the regenerated catalyst, operations would not have been satisfactory. Also if some other form of sulfur in the gas-oil charge had been involved it is possible the same results would not have occurred.

It should also be noted from this experience that hydration steam has the property of reactivating or "cleaning up" catalyst that has been sulfur poisoned. This phenomena had been observed in the Gulf and other laboratories, and was one of the major factors in promoting hydration of re-

TABLE 4—DAILY FLUID UNIT OPERATION

	Regular natural catalyst—Avg. daily operating summary for 1-week period ended Feb. 27, 1949		S.R. natural catalyst: Data from test run No. 17, 24-hour period ended Sept. 2, 1949		S.R. natural catalyst: Data from test run No. 18, 24-hour period ended Nov. 16, 1949	
Charge:	Bbl. per stream day	Vol. %	Bbl. per stream day	Vol. %	Bbl. per stream day	Vol. %
Fresh feed	18,260	100.0	20,488	100.0	25,000	100.0
Heavy gas-oil recycle	2,358	12.9	2,804	13.7		
Slurry-oil recycle	521	2.9	602	2.9	426	1.7
Rerun tower bottoms			414	2.0		
Yields:						
Gas, incl. C. (F.O.E.)	1,568	8.7	1,464	7.2	2,268	9.1
Butanes-Butenes	1,990	10.9	1,868	9.1	2,034	8.1
Gasoline distillate:						
Light	5,180	28.4	5,804	28.3	6,562	26.2
Heavy	3,029	16.6	2,894	14.1	3,306	13.2
Fuel distillate No. 2	4,857	26.6	4,187	20.4	5,168	20.7
Heavy gas oil	(Recycled 100%)		3,042	14.9	3,956	15.8
Decanted oil	1,884	10.3	1,666	8.1	2,204	8.8
Coke:						
Carbon per hour in lb.	15,335	*6.3	13,366	*4.9	14,915	*4.5
Hydrogen per hour in lb.	1,875	*0.8	2,569	*0.9	2,589	*0.8
Still conditions:						
Reactor	940° F. ±10.9		930° F. ±9.9		931° F. ±11.9	
Regenerator	1,055° F. ±5.9		1,064° F. ±5.0		1,072° F. ±4.7	
C/O ratio, total feed	12.4		10.8		11.2	
C/O ratio, fresh feed	14.3		12.8		11.0	
W/hr./W, total feed	1.63		4.35		2.41	
Hydration steam, lb. per hr.	3,000		0.0		0.0	
Dispersion steam, lb. per hr.	14,600		7,200		7,200	
Stripping steam, lb. per hr.	25,700		17,980		18,330	
2-hr. Kellogg activity	27.4		24.9		22.5	
Flue-gas analysis:						
Per cent CO_2	11.2		7.8		8.2	
Per cent CO	5.1		5.9		6.7	
Per cent O_2	1.9		3.4		3.3	
Inspections:						
Charge stock:						
Crude source of gas oil:	Vol. %		Vol. %		Vol. %	
Eastern Venezuela	4.8		30.0			
Kuwait	44.8		70.0		100.0	
Ord.-Van-Delta	15.7					
West Texas	34.7					
Gravity, °A.P.I.	23.8		23.2		22.7	
Viscosity, S.U.V., 130° F.	122		116		115	
Flash, P-M, °F.	260		275		360	
Pour, °F.	+85		+100		+95	
Color, N.P.A.	Dark		3.75 dil.		4.75 (1_2" cell, diluted)	
Sulfur, per cent	1.73		2.37		3.07	
Carbon residue	0.50		0.47		0.51	
Aniline point, °F.	187.8		178.4		174.7	
Distillation (vacuum corr. to 760 mm.):						
Over point	655		650		620	
10 per cent	670		683		705	
50 per cent	835		825		825	
90 per cent	955		988		915	
Butane-butene:	Liq. Vol. %		Liq. Vol. %		Liq. Vol. %	
Propene	2.4		3.0		2.1	
Propane	3.0		2.4		2.4	
Isobutane	20.8		24.6		22.5	
Butenes (other than iso)	34.5		34.7		30.3	
Isobutane	24.8		24.5		28.4	
Normal butane	14.0		10.7		12.8	
Pentanes-pentenes	0.5		0.1		1.5	
Motor gasoline:	Light	Heavy	Light	Heavy	Light	Heavy
Gravity, °A.P.I.	68.1	39.9	66.7	40.1	67.7	40.1
Sulfur, lamp, per cent	0.07	0.22	0.12	0.50	0.15	0.70
Acid heat	206	43	212	66	208	64
Octane number:						
A.S.T.M., clear	78.9	77.7	78.0	76.5	79.0	77.7
3 cc. TEL	83.2	82.8	82.0	80.2	81.8	80.5
Research, clear	95.1	90.0	94.8	89.2	94.7	88.9
3 cc. TEL	98.8	95.1	98.0	93.0	97.5	92.9
R.v.p.	7.5		8.0	0.6	8.6	0
Distillation, A.S.T.M.:						
O.P.	116	283	110	265	104	267
End point	288	423	326	428	323	431
10 per cent at	134	310	126	294	125	291
50 per cent at	170	338	179	350	168	344
90 per cent at	232	388	269	402	262	400
Recovery, per cent	98	98	98	98	98	98
Residue, per cent	1	1	1	1	1	1
Loss, per cent	1	1	1	1	1	1
Fuel distillate No. 2:						
Gravity, °A.P.I.	22.5		22.1		20.1	
Sulfur, lamp, per cent	1.52		2.38		2.63	

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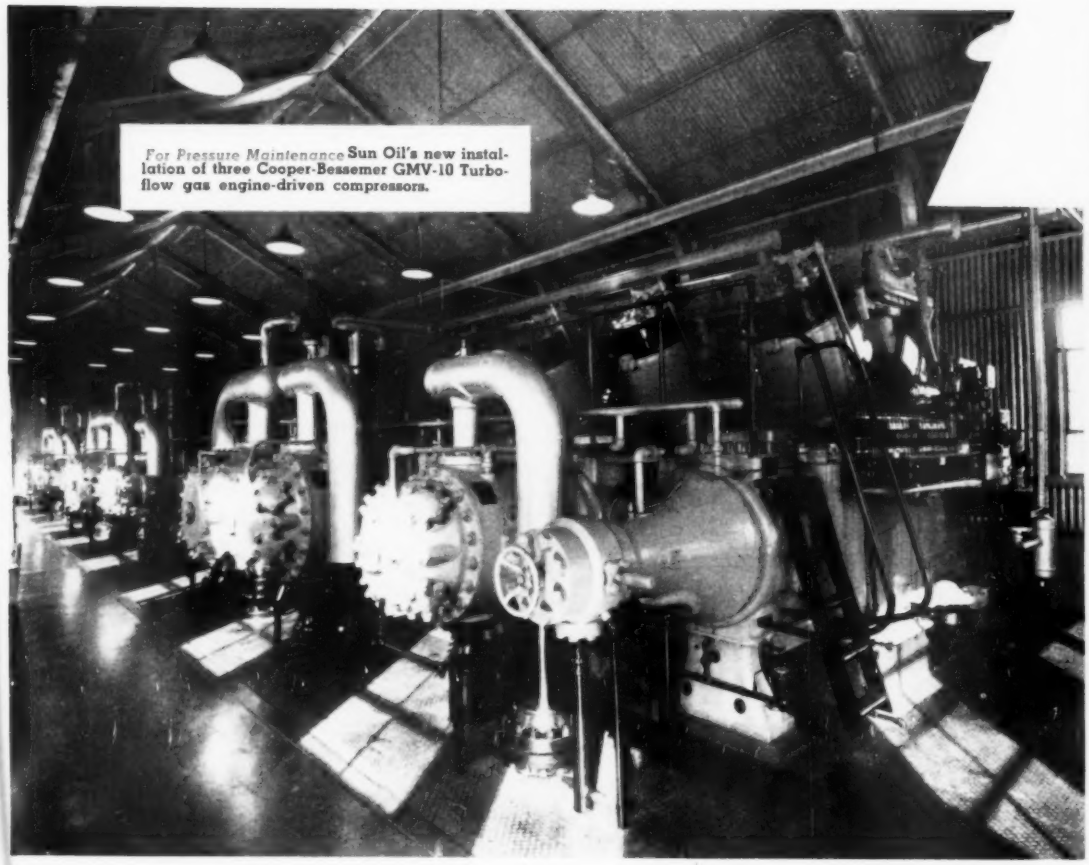

For Pressure Maintenance Sun Oil's new installation of three Cooper-Bessemer GMV-10 Turboflow gas engine-driven compressors.

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Sun Oil's new field plant makes available about 8,000,000 cubic feet of high pressure gas for return to the oil producing horizon . . . and recovers up to 30,000 gallons of natural gasoline and butane-propane fractions daily.

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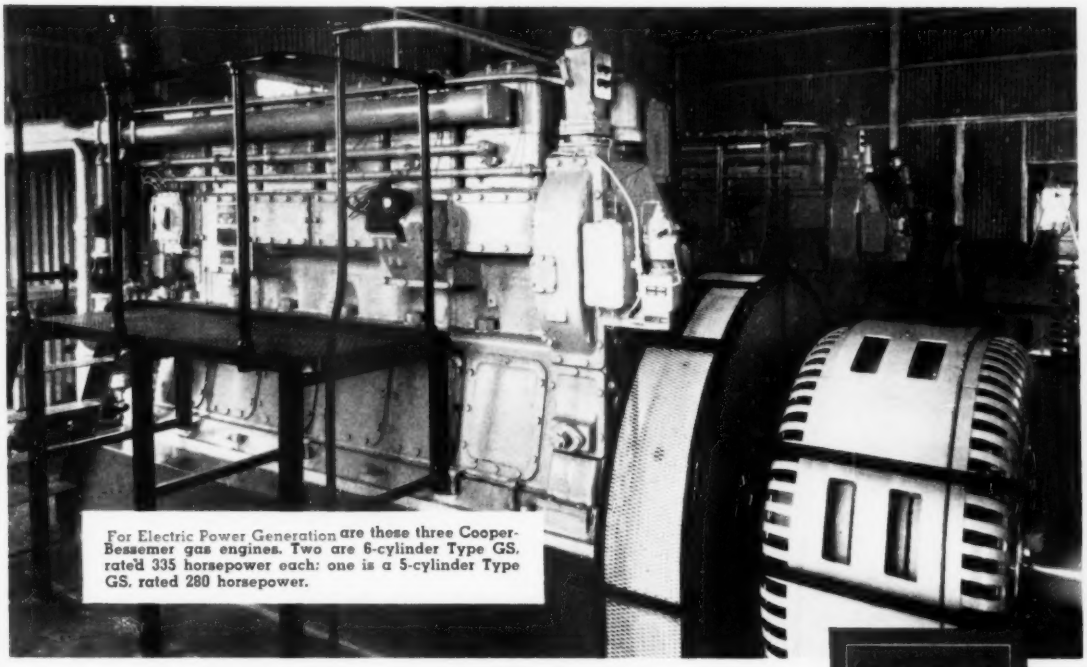

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The selection of Cooper-Bessemer Turboflow engines and compressors means a saving of up to 25% in space, in foundation, in cooling equipment and in fuel consumption compared with engines of equal displacement.

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generated catalysts for commercial operation.

The only natural catalyst available commercially, other than that used in the Philadelphia unit for operation up to this point and hereafter referred to as regular natural catalyst, was a new catalyst recently developed, low in iron content and consequently assumed to be resistant to sulfur poisoning. This sulfur-resistant catalyst, commonly abbreviated S.R., was submitted to Gulf for laboratory examination and possible commercial adoption.

A typical analysis of the regular and S.R. natural catalysts is given in Table 2. Unfortunately this new catalyst did not show up too well in the preliminary bench-scale testing, its initial activity being particularly low by the standard Kellogg activity test. Since the Kellogg activity test is obtained by charging a standard oil for 2 hours at 850° F. with a space velocity of 0.6 W/hr./W it should not be surprising if this test did not reflect the true value of a catalyst when later used in a commercial fluid unit.

A modified Kellogg test was developed by Gulf which would be more indicative of actual plant operating conditions. This so-called "Half-Hour Kellogg Activity Test" is run for 30 minutes at 900° F. and a space velocity of 1.0 W/hr./W using the otherwise usual charge stock and techniques of the 2-hour Kellogg test. Table 3 compares the usual Kellogg test with this new shorter period test on the regular natural catalyst and the new S.R. natural catalyst.

The surface area of fresh S.R. catalyst is about 130 sq. meters per gram, considerably below the 250 to 325 sq. meters per gram surface area of fresh regular natural catalyst. However, from Table 3 this difference in surface area does not appear to be a disadvantage. It should be noted that the carbon factor was actually decreased by pilot-plant aging. Also the effect of hydrogen sulfide was much less on the S.R. than the regular natural catalyst.

Since the production of S.R. catalyst was just beginning it was impossible to consider shutting down the Philadelphia fluid unit to replace the inventory with fresh S.R. In order to maintain an economical selectivity, due to the rapid poisoning of the circulating regular natural catalyst, it was realized that the addition rate of this new S.R. catalyst would necessarily be high at the start until the inventory was predominately S.R.

The addition of S.R. catalyst was started in April 1949 with an addition rate of 10 to 12 tons per day. The previous addition rate of 15 to 20 tons per day of regular natural catalyst had maintained an average catalyst age of between 20 and 25 days. The S.R. catalyst addition rate has been steadily tapered off from the initial 10 to 12 tons to a current 2 to 3 tons rate with a corresponding catalyst average age increase to between 90 and 95 days. If this rate could be maintained the average age would rise eventually to 250 days.

Because of the usual metallic contaminants found in gas-oil charge stocks prepared by vacuum distillation, the limiting factor governing catalyst makeup rates will be the nickel and vanadium laydown on the catalyst, not decline in activity. The current circulating inventory can be considered as 100 per cent S.R.

Table 4 is a summary of operating and yield data for past operations on regular natural catalyst immediately prior to the addition of S.R. catalyst, and recent operations on the S.R. natural catalyst. It is felt that increasing the regenerator temperature above the 1,070° shown would increase the coke burning capacity of the unit but this point cannot be explored because of design limitations. The large decanted oil make is governed by the fact that the heavy gas-oil stripper is overloaded at these high charge rates and therefore some of the heavy gas oil is actually being withdrawn as decanted oil.

The flue gas analysis is more similar to that expected from a synthetic silica alumina catalyst than the regular natural catalyst. Also the coke deposited on the S.R. catalyst is between 14 and 16 per cent hydrogen which corresponds to a relatively light molecular weight hydrocarbon to be "coke." The low surface area of the S.R. catalyst compared to its activity may be the determining factor in this coke composition.

Laboratory inspection of the circulating S.R. catalyst is shown in Table 5. The sum of the nickel and vanadium has reached 0.043 weight per cent and it may well be that this will become the factor determining catalyst makeup rate.

Since the final equilibrium catalyst conditions have not yet been reached, it is impossible to draw conclusions as to the eventual value of the S.R. natural catalyst. However, Gulf Oil Corp. is currently successfully cracking high-sulfur stocks over S.R. natural catalyst with a satisfactory product quality and distribution. The catalyst makeup rate is low and this makeup rate compares favorably with any of the synthetic catalysts available.

TABLE 4—DAILY FLUID UNIT OPERATION (Continued)

	Regular natural catalyst— Avg. daily operating summary for 1-week period ended Feb. 27, 1949		S.R. natural catalyst: Data from test run No. 17, 24-hour period ended Sept. 2, 1949		S.R. natural catalyst: Data from test run No. 18, 24-hour period ended Nov. 16, 1949	
Charge:	Bbl. per stream day	Vol. %	Bbl. per stream day	Vol. %	Bbl. per stream day	Vol. %
Distillation, A.S.T.M.:						
O.P.	420		472		450	
End point	650		638		648	
10 per cent at	470		496		507	
50 per cent at	550		536		549	
90 per cent at	615		603		614	
Recovery	98		98		98	
Residue	1		1		1	
Loss	1		1		1	
Heavy gas oil:						
Gravity, °A.P.I.	18.5		20.1		19.9	
Distillation, A.S.T.M.:						
O.P.	500		430		645	
10 per cent at	625		638		680	
50 per cent at	670		686		745	
Decanted oil:						
Gravity, °A.P.I.	10.1		10.4		8.9	
Viscosity, S.U.V. at 130° F.	98		160		172	
Pour	+90		+90		+85	
Regenerated catalyst:						
Carbon, weight per cent	0.71		0.72		0.68	

*Weight per cent. †Psig.

TABLE 5—LABORATORY INSPECTIONS OF S.R. CATALYST CIRCULATING DURING TEST RUN NO. 18

	2-hour test	½-hour test
Activity testing data:		
Conversion, vol. %	22.5	28.3
Carbon factor (from wt. % carbon)	1.82	1.54
Hydrogen factor	4.75	5.23
Carbon factor (from e.f. bbl. hydrogen)	1.35	1.40
Gas gravity (air = 1)	0.788	0.930
Gasoline, vol. %	0.962	0.840
Conversion, vol. %		
Surface area, m.²/g.	48.5	
Quantitative analysis, wt. %:		
Fe_2O_3	0.51	
Na	0.19	
V	0.30	
Ni	0.013	
Roller analysis, wt. %:		
0-10 microns	2	
10-20 microns	8	
20-40 microns	29	
40-80 microns	34	
80+	27	
Bulk density, lb./cu. ft.:		
Aerated density (loose)	53.8	
Freely settled	57.8	
Compacted	72.6	

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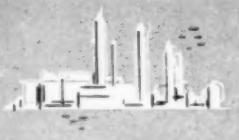
SOUR NATURAL GAS



Hydrogen sulfide gas in sour residue gas from gas-gasoline operations is a large potential source of elemental sulfur.

FLUOR
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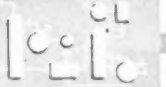
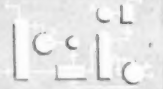


for the recovery of H_2S from sour gases

SOUR REFINERY GAS

Hydrogen sulfide gas in sour refinery gas from the processing of sour crude oil is a potential source of elemental sulfur.

FLUOR
Gas-Treating Process



for the recovery of H_2S from sour refinery gases

* *The first Sasco Process Plant was built by Southern Acid and Sulfur Company in 1942. Acquisition of this company by Mathieson Chemical Corporation, and continued research and development by Mathieson personnel mark this process for recovery of sulfur from waste hydrogen sulfide gas as the only one developed in the United States with a record of several years' successful operation.*

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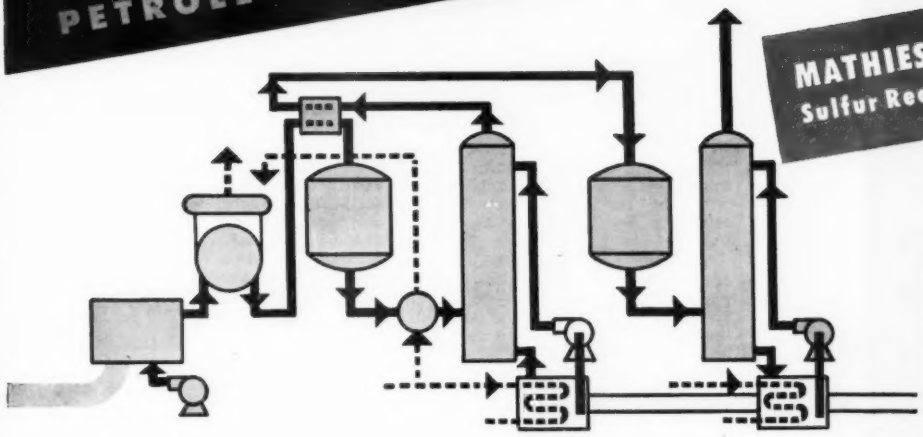

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Economics of Power Generation

at Sinclair's East Chicago Refinery

by William H. Decker

THE history of the steam and electrical energy-generating facilities at the East Chicago refinery of Sinclair Refining Co. is essentially one of continuous progress. It portrays the development from a dependent beginning to its present state of independence from outside energy sources.

Initially all electrical energy was purchased and the plant boilers generated 125 psi. steam. This steam pressure was too low either to produce byproduct power or to drive any prime movers and utilize the exhaust steam for process use other than heating in the refinery. The next step in the development of the refinery utilities was the installation of two 400-psi. boilers to supplement existing low-pressure units. Advantage was taken of this higher-pressure steam to drive such prime movers as forced and induced-draft fans and several hot-oil pumps. This step reduced both electrical energy consumption and steam requirements from the low-pressure boilers as these prime movers exhausted into the 125-psi. lines.

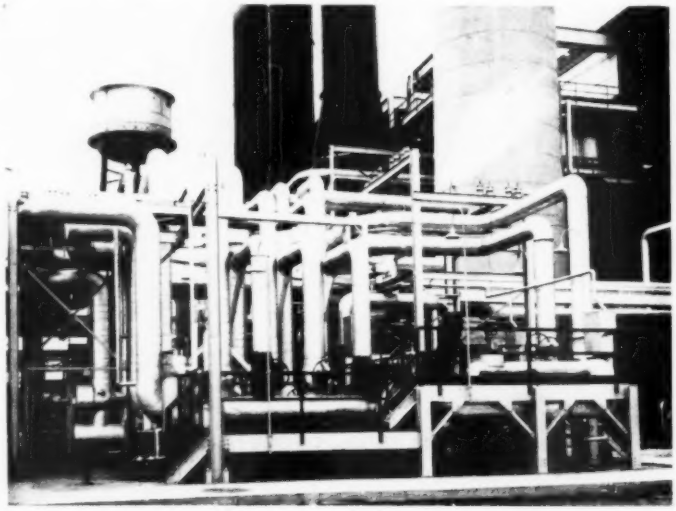
The next, and final step was to produce steam at 900 psi., 900° F. and then develop all electrical energy required by means of single extraction, noncondensing, turbine driven generators. The extraction steam at 550 psi. was used both for process reboilers and for certain high back-pressure prime movers. Exhaust steam from these turbines at 125 psi. was used largely for low-pressure prime movers and finally the exhaust from these units provided process and heating steam.

Before the 900-psi. boilers were built it was realized that perhaps the steam pressure should have been increased to 1,500 psi. for an even more economical steam-energy balance. The future may demonstrate refinery boilers operating at 2,500 psi. or even at the critical steam pressure with the same feeling of security as is now the case with the 900-psi. boilers. It is entirely within the realm of probability that we may even equip our refineries in the future with the recently developed high efficiency gas turbines as prime movers.

With the new 900-psi. boilers the greatest proportion of the steam requirements can be produced at high efficiency levels and the old less-efficient low-pressure boilers can be shut down the greater part of the time, resulting in better operating economy. In addition to these fuel savings, the out-of-pocket cash for electrical energy generation can be reduced tremendously.

Components of Station

In brief the East Chicago refinery steam and power station consists of a water-treating unit, three 125-psi. boilers, two 400-psi. boilers, three 900-psi. outdoor-type boilers, and three 6,000-kw. electrical generators. The boiler feed-water treating unit consists of a two-stage hot-process lime and soda unit followed by a



Pressure reducing and desuperheating stations in the East Chicago refinery of Sinclair Refining Co.

The author is assistant chief combustion engineer at the East Chicago refinery of Sinclair Refining Co. Decker joined Sinclair in 1942 after graduation from University of Colorado with a B.S. in chemical engineering and was appointed to his present position in 1949. He is a member of the American Institute of Chemical Engineers and the American Institute of Mechanical Engineers.

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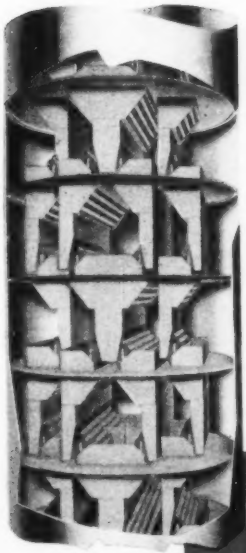

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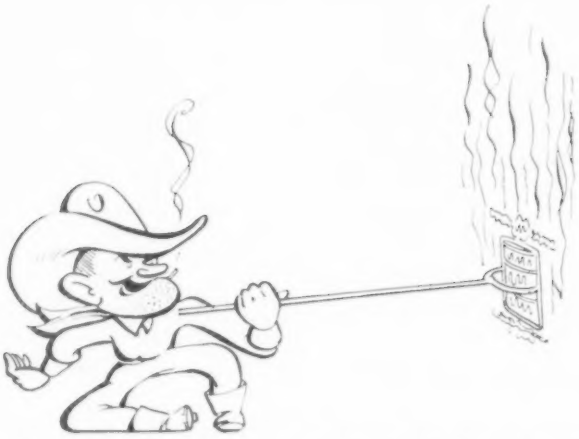

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secondary hot phosphate softener located out of doors. Effluent water from this hot phosphate treater flows by gravity through a bank of filters, from which it is pumped to twin deaerating feed-water heaters. The boiler-feed pumps take suction on the feed-water heaters and supply water directly to the boilers. This unit is capable of supplying 1,000,000 lb. per hour of 0-0.5-p.p.m. hardness water at 240° F. for boiler-feed purposes.

The filtering system has been equipped with a unique backwash arrangement. This consists of a separate backwash tank so connected to the treating system that no wash water is wasted or returned to the softener cycle. After backwashing a filter, this water is allowed to settle and the sludge drawn off manually to the sludge pit. The clean settled water in this backwash tank then enters the treated water line during filter backwashing.

Both the 400 and 900-psi. boilers are high-efficiency units equipped with forced and induced-draft fans and regenerative-type air preheaters. The 900-psi. boilers are each supplied with dual fans and air preheaters, which allows for repairs and maintenance of faulty equipment with only a 25 per cent reduction in total output of the unit undergoing repair. This additional equipment cost is easily justifiable as these units operate in excess of 85 per cent efficiency, which represents a tremendous fuel savings over the old 75 per cent efficient low-pressure boilers (125-psi.). In addition it is to be noted that these new units can handle equally well, in any combination, all types of fuels, solid, liquid, or gaseous and they are provided with complete dust-collecting and ash-handling equipment.

Design of Plant Steam System

The 125 and 400-psi. boilers are intended at the present time to serve primarily as standby units in the event of outage of the 900-psi. boilers. The plant steam system is so designed that no 900-psi. steam is used for any process operation other than generator turbine throttle steam and for the high-pressure reducing stations. This arrangement reduces the first cost and maintenance on 900-psi. transmission lines as all of these lines in the boiler house-generator station area are of relatively short length.

The electrical - energy - generating equipment for the plant consists of three 6,000-kw., 0.8-power factor, 11,500-volt, 3-phase, 60-cycle single-automatic-extraction, noncondensing turbine-driven generators. Inasmuch as there are a large number of synchronous motors throughout the refinery, the power factor of the plant system approaches unity and under these conditions the machines are capable of delivering 7,500 kw. each, for a total of 22,500 kw. This capacity will allow amply for any presently predicted refinery expansion.

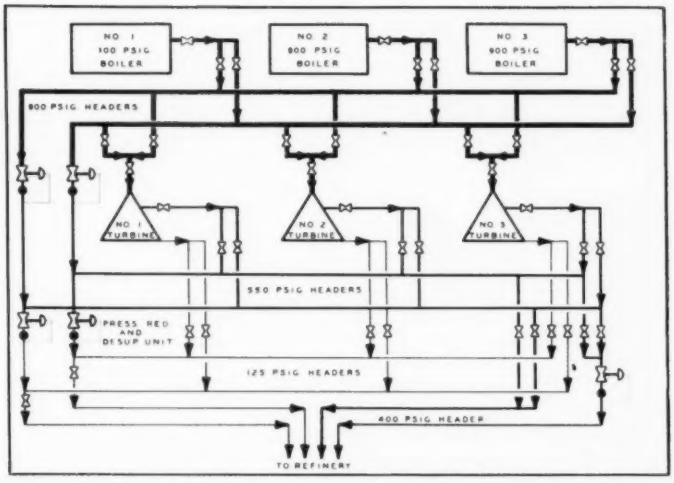
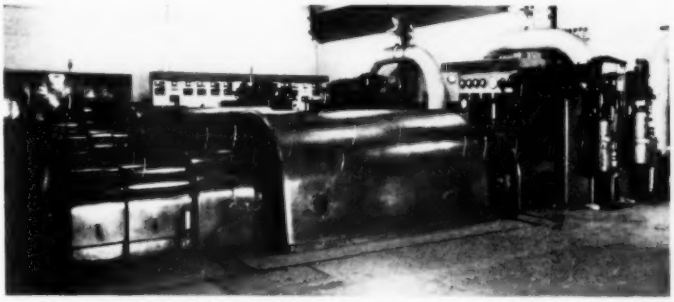


Fig. 1—Diagrammatic layout of piping system for the 900-psi. boilers, the pressure reducing-desuperheating stations, and the turbogenerators.



Turbogenerator room of Sinclair's East Chicago refinery.

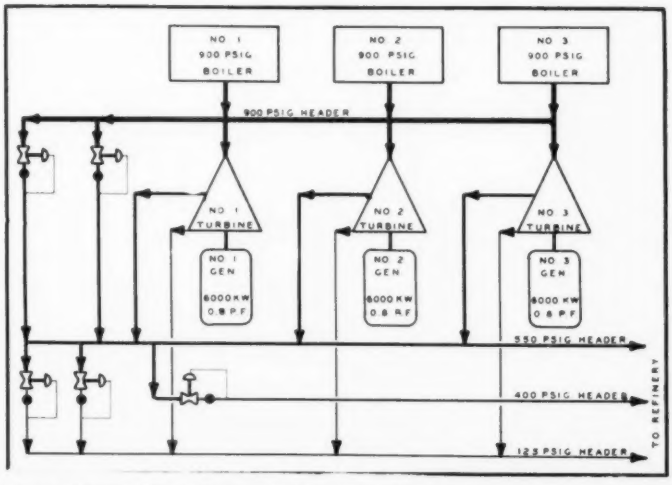

NO. 1 900 PSIG BOILER
NO. 2 900 PSIG BOILER
NO. 3 900 PSIG BOILER
900 PSIG HEADER
NO. 1 TURBINE
NO. 2 TURBINE
NO. 3 TURBINE
NO. 1 GEN 6000 KW 0.8 P.F.
NO. 2 GEN 6000 KW 0.8 P.F.
NO. 3 GEN 6000 KW 0.8 P.F.
550 PSIG HEADER
400 PSIG HEADER
125 PSIG HEADER
TO REFINERY

Fig. 2—Schematic flow diagram of high-pressure boilers—turbogenerators—pressure-reducing, and desuperheating stations.

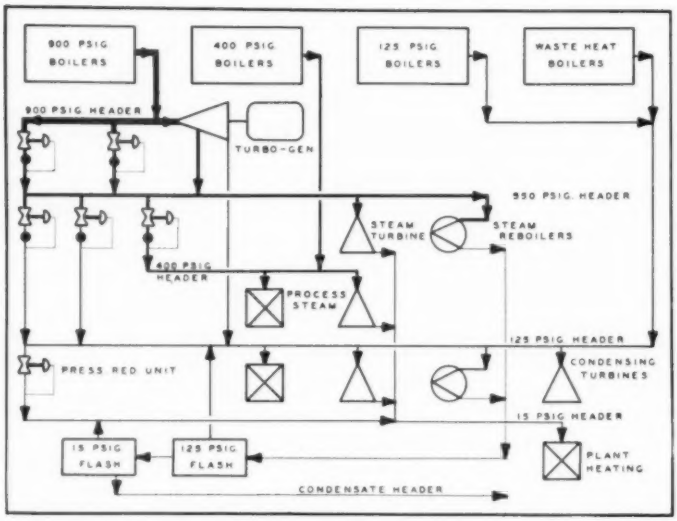


Fig. 3—Schematic flow diagram of electrical-energy generating and steam-distributing systems

Operating in conjunction with these turbogenerators are a number of pressure-reducing and desuperheating units including two 900-550-psi. stations, two 550-125-psi. stations, and one 550-400-psi. station. Automatic regulation from a central control panel, of both temperature and pressure for each station insures continuous trouble-free operation. All pressure-reducing and desuperheating stations are located out doors with control panel inside the boiler room.

It is of interest to review the actual arrangement of this equipment. This layout is such that any valve in the entire system may be repaired by shutting down either a boiler or a turbogenerator without curtailing plant operations. This is accomplished by means of a double-header system and a special valving arrangement. There is no steam valve in the 900 or 550-psi. system larger than 12 in. although the main 900-psi headers are 16 in. in size. Other arrangements making use of a double block and bleeder would be no more flexible, would require more space, and would be almost prohibitive in first cost. Fig. 1 is a diagrammatic layout of this piping for the 900-psi. boilers, turbogenerators, and pressure-reducing stations.

Because of the importance of the pressure-reducing stations to the operation of the turbogenerators it will be in order to review this relationship in more detail. When using this type of equipment it is of primary importance to meet under all conditions of refinery operations, two basic requirements; electrical-energy loads together with 550, 400, 125, and 15-psi. steam demands. If either of these requirements is not satisfied then plant processing may be curtailed or inefficient operation may result. Reference should be made to Fig. 2 to supplement this discussion.

In essence this type of turbogenerator is little more than a pressure-reducing station as the extraction and exhaust steam from the machine will be equivalent in pressure to steam supplied from the reducing stations. These machines extract a small fraction of the total heat energy in the throttle steam and convert this heat into electrical energy. For the machines in service at the East Chicago refinery this rate of energy conversion is approximately 4,000 B.t.u. per kw. It can, therefore, be seen that all of the 550, 125, and indirectly the 400-psi. steam should be supplied to the plant headers through the turbogenerators thereby producing cheap power as a byproduct.

If the steam-energy balance in the plant is such that all steam required can be supplied through the turbogenerators than a condition of maximum economy results, since no steam would be pressure reduced from the 900-psi. header. However, this is not as a rule normally true, and it then becomes necessary to adjust operations so that, consistent with the base energy demands, the flow of steam through either the 900-550 or 550-125-psi. reducing stations is at a minimum.

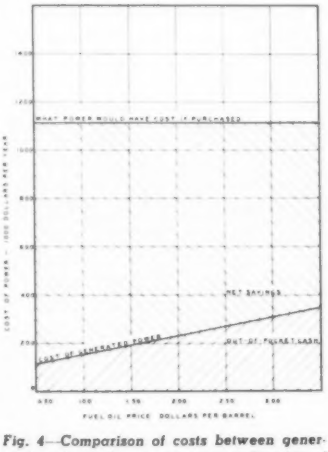

WHAT POWER WOULD HAVE COST IF PURCHASED
NET SAVING
COST OF GENERATED POWER
NET OF FUNNEL LOSS
FUEL OIL PRICE DOLLARS PER BARREL

Fig. 4—Comparison of costs between generated and purchased power as a function of varying fuel oil price.

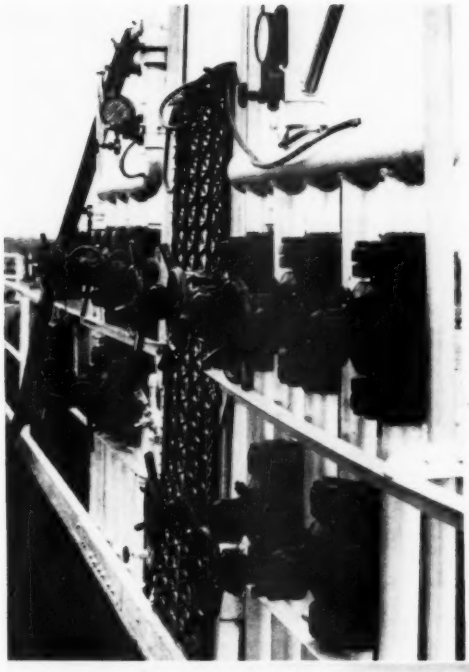
Control of System

The control of this system is so arranged that pressure in the 550-psi. line is held by automatic regulation of the turbine extraction valves. The reducing stations act as auxiliary controls to hold constant pressures in the 550, 400, and 125-psi. steam headers. The steam system for the entire refinery shown on Fig. 3 is of the conventional type and is so arranged to supply steam for plant turbines, reboilers, process use, and heating. All condensate which can be collected economically is returned to the boiler feed-water cycle so as to reduce raw-water treating costs.

This discussion has outlined briefly the control and operation of the power-generating station with its attendant pressure-reducing equipment. There is, however, one additional and perhaps more important control for the steam system and that is the plant exhaust steam line (15 psi.). It can be understood that it is imperative to maintain an exact balance on the 15-psi. line since it is undesirable, from both economy and processing standpoints, to have either an excess or deficiency of exhaust steam.

This system must be kept in balance with, both a minimum of 125-psi. steam-pressure reduction in the event of a deficiency in the exhaust header, or a minimum of 15-psi. steam wastage to the atmosphere in the event of an excess in the exhaust header. Thus, since the plant exhaust-steam line serves as the master control point for the entire refinery steam-energy distribution, it becomes absolutely essential to maintatin a continuous close surveillance of the exhaust-steam-line balance, because of variations in plant processing conditions, different weather conditions, etc. Changes in this line are made when necessary by the swinging of a motor to turbine drive and vice versa on various process pumps.

It is perhaps not understood that there is a marked difference between summer and winter operations. This difference can be explained by the fact that during winter operation the heating steam load (15 psi.) is quite high. This necessitates the operation of a large number of low-pressure process turbines exhausting into



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the 15-psi. line. If the 125-psi. steam is supplied through the turbogenerators then it is possible to produce a large amount of cheap byproduct power for which, since practically all turbine drives are in use, there is less demand. In contrast to this, during summer the opposite condition is true and there may be a shortage of power since the electrical demand is high occasioned both by a lowered heating steam load requiring fewer low-pressure turbines in operation, and because of cooling-water-system electrical loads, including pumping and cooling-water fans, are much greater than in winter.

The utility of a byproduct power-generation unit such as this is a function of the versatility of the entire plant steam and energy-distribution systems. To illustrate the necessity of this flexibility the following example will be reviewed: Assume that at a given electrical demand rate no steam is flowing through the reducing stations from the 900-psi. line to either the 550 or 125-psi. plant steam headers. Under these conditions the system is operating under optimum efficiency as explained above. Further assume that the electrical demand increases; since the steam lines are in balance no additional energy can be generated until these steam line conditions are changed.

The following is an outline of the steps to be taken to have a surplus of energy available.

1. A 450-hp. motor drive with a 450-hp. turbine spare drive for a process pumping unit will be considered for the example. The turbine drive operates with 125-psi. throttle steam, exhausting to the atmosphere, and under these conditions has a water rate of 35 lb. per horsepower-hour.

2. The changeover of the motor drive to the turbine drive will reduce the electrical energy demand by 370 kw.

3. The 125-psi. steam demand will correspondingly increase by 16,000 lb. per hour.

4. This additional 16,000 lb. per hour of steam originating at 900 psi. and exhausting through the turbogenerators at 125 psi. will generate 900 additional kw.

5. The net gain is then approximately 1,270 kw.

6. This net gain in energy would of course be proportionally more if the process turbine in question exhausted into the 15-psi. exhaust steam line instead of to the atmosphere as the water rate would be higher.

The final analysis of the above set of conditions indicates that the additional 1,270 kw. were produced at a generating water rate of about 12 lb. per kw. This figure rather closely approaches that which is realized when operating condensing-type machines. It will be readily seen, from a study of this example, that the inherent success of this type of byproduct power-generating system lies in the fact that there must be a wide variety of process motor-turbine combinations in the plant of varying horsepower and type of turbine drives, including condensing and noncondensing units.

The installation of condensing turbines may appear to be questionable because of the additional equipment involved, the cost of water pumping, and other factors. However, that this may be a wise choice is demonstrated by a consideration of prime movers for the four 900-psi. boiler-feed pumps. An analysis of the refinery steam-energy balance indicated that had these pumps been driven by high back-pressure turbines that the over-all steam-energy balance would have been altered to the extent that all of the necessary byproduct power could not have been produced.

Likewise had these units been motor driven then the steam-energy picture might have been unbalanced from an energy standpoint. It was largely because of these reasons that condensing turbines were chosen with a system whereby all the partially heated condenser water was collected and returned to the cycle as raw boiler feed water. With such an arrangement the demand for 15-psi. steam for feed-water heating was materially reduced and the actual steam-energy balance has been satisfactory. Therefore because of the wide range of process prime movers available in the East Chicago refinery it becomes a simple matter to select that combination of equipment, which when changed, will result in the desired adjustment to the steam-energy balance.

In reviewing the over-all steam-energy balance, several facts bear particular emphasis. The proper distribution of steam versus energy within the plant is quite critical. Unless the correct balance is maintained at all times, it will be found that either the generation of the required energy is adversely affected or uneconomical operation results from an excessive reduction of high-pressure steam and/or steam wastage to the atmosphere. It should be remembered that every change in weather conditions, variations in plant processing, still outages, all have a definite and pronounced effect on the over-all utility picture and as a consequence continual attention is required to insure optimum operation and economy.

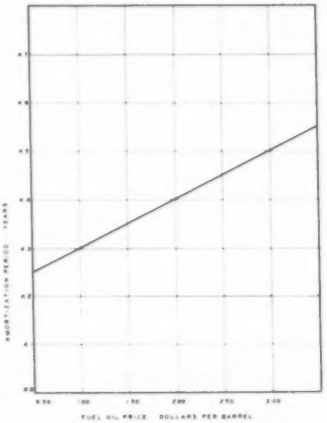


Fig. 5—Amortization period for power generation as a function of varying fuel-oil price.

The previous discussion has dealt largely with review of the equipment involved in this byproduct power-generating plant and a review of the operation of such equipment. There is, however, an even more important aspect and that is the question of the economy. The consideration of byproduct power generation as an incidence to other operations in the refinery must include a thorough review of both generating costs and payout periods.

The direct costs of byproduct power generation are largely a function of the following factors:

1. Fuel cost.
2. Generator-room operating labor and supplies.
3. Generator-room repair labor and materials.

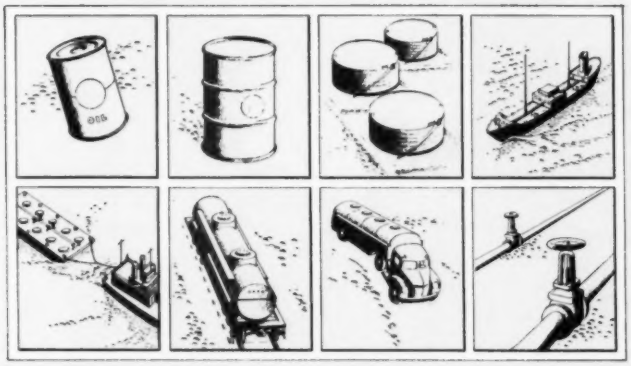
Fuel costs have the most effect on the cost of generating byproduct power. The other factors affecting generated power costs are those of operating repair labor together with operating repair supplies and materials. For the East Chicago refinery these costs have been fixed at the following levels. To insure continuous operation and to provide for power distribution throughout the plant, two men per shift are required in the generator room. At current labor rates this would amount to $120 per day.

Operating supplies are normally of such small magnitude that they may be neglected in a review of this nature. To date the repair labor and materials costs have been quite small; however, it is in order to assign a reasonably long-range value for such items and therefore a cost of $10,000 per year per machine has been selected. It is recognized that maintenance costs of turbogenerators are normally below that for other refinery equipment and therefore it is believed that the above figure is ample.

A study of both the past year's operations and the planned operations in the near future has indicated that the average energy demand for the East Chicago refinery approximates 14,000 kw. per hour throughout the the year. This energy load if purchased from outside sources would have to be paid for at a rate of approximately 9 mills per kw. at present utility rates. This energy rate is a function of public utility fuel and labor costs and may be subjected to

(Continued on page 345)

Which fits into



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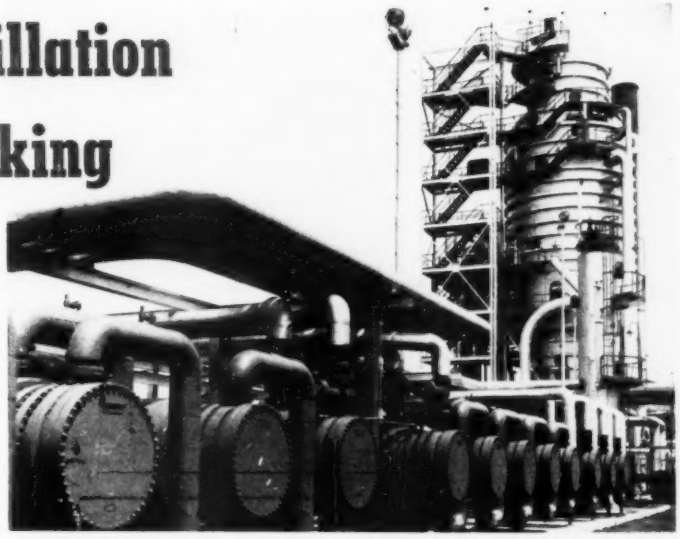
Vacuum Distillation And Vis-Breaking

Their Application In Modern Refining

by Roger W. Williams* and John M. Naugle†



Exchanger battery and column in Esso Standard's vacuum pipe still at Bayway.

VACUUM flash units recently installed in refineries of various affiliated companies of Standard Oil Co. (N. J.) have been an important link in the ever-present problem of reducing residual fuel-oil production. Designed to produce a gas-oil cut, suitable as feed stock for new or expanded fluid catalytic cracking plants, these vacuum flashers have made possible recovery of heavy gas-oil fractions boiling in the range of 800 to 1,100° F. This increase in cut point represents an appreciable upgrading of atmospheric pipe-still bottoms from fuel oil or thermal cracking coil feed to fluid catalytic cracking feed, yielding more valuable light distillates obtained from catalytic cracking.

The lower per cent bottoms, resulting from the increased cut points obtained in these flash units, have been sent to vis-breakers for further reduction, or blended into residual fuel.

Minor changes reflected by local refinery needs and by local economic factors differentiate the several new units. However, the simplified flow plan, Fig. 1, of the new Bayway vacuum pipe still is representative of the units recently installed. Reduced crude from atmospheric distillation units is preheated in conventional shell-and-tube exchangers before entering the furnace. Partially vaporized feed stock at a coil outlet temperature of 800° F. enters the tower flash zone, maintained at about 60 mm. Hg. abs. Here the two-phase mixture is separated into its constituent parts. The liquid portion of the charge drops into a stripping section where superheated exhaust steam strips out recoverable gas-oil fractions.

Bottoms from the unit after heat exchange with the incoming feed are pumped to vis-breaking units for further reduction or sent to fuel through suitable fluxing and cooling facilities. Flashed and stripped vapors ascend the tower to be condensed on pump-around reflux condensing and product withdrawal sections. The gas-oil product is withdrawn and pumped to the fluid catalytic cracking plants. Steam and noncondensable gases are evacuated through two-stage steam jet ejectors.

Design Carefully Considered

In each of the new units recently installed the design has been carefully considered so that the vacuum pipe stills have been fully integrated with other process units, and with the refinery's over-all utility picture. Sufficient flexibility has been included to permit operation over wide ranges of feed rate with varying types of crude. Recent installations of these dual-purpose vacuum-flash units have been made in four refineries. Pertinent information summarizing the feed and product design rates and gravities as well as time and place of installation is given below.

Location and date—	Feed		Total gas oil		Bottoms	
	B/SD	°A.P.I.	B/SD	°A.P.I.	B/SD	°A.P.I.
Baton Rouge, Nov. 1948	18,500	23.4	16,440	25.6	2,060	9.0
Baton Rouge, Dec. 1948	14,500		10,440		4,060	
Bayway, June 1949	49,000	11.6	23,000	16.0	26,000	7.0
Billings, June 1949	4,840	8.0	2,200	16.0	2,640	4.5
Baltimore, Dec. 1949	13,000	13.5	7,000	19.0	6,000	7.3

Yields from Individual Process Units

To illustrate the effects of vacuum distillation, estimates were made of the yields obtainable from processing two domestic crudes in modern refinery equipment. West Texas was selected as being a typical domestic sour fuel crude of approximately average gravity, and South Louisiana is typical of sweet domestic crudes from which substantial yields of good quality kerosine may be cut. Table 1 shows the initial yields obtained at the pipe stills from both atmospheric and vacuum distillation.

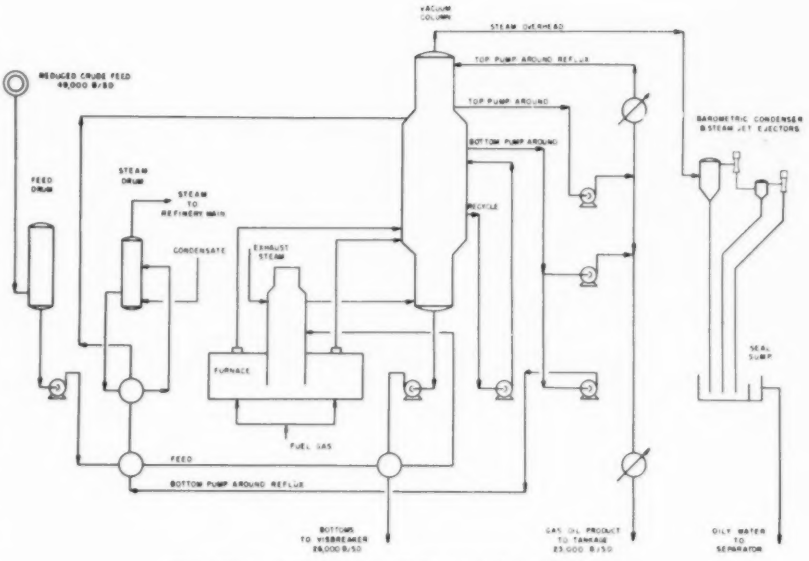
The cracking operations in a refinery are, of course, directly affected by the installation of vacuum distillation. Changes in heavy naphtha reforming, which result indirectly from the impact of the more intensive processing upon gasoline quality, will be discussed later. Other changes are brought about by the realignment of the feed stocks themselves, and the cracking yields which may be obtained from these various feed stocks are summarized in Table 2. In a refinery which has only atmospheric crude distillation, the process stocks charged to the cracking units may consist of relatively light gas oil and long reduced crude. The same refinery, after building a vacuum pipe still, will have a supply of heavy vacuum gas oil in addition to the light for cracking; and vis-breaking of the vacuum pitch bottoms may be substituted for the cracking or vis-

*Technical service division, Esso Standard Oil Co. †Standard Oil Development Co.

breaking operation on the atmospheric bottoms.

Perhaps the most striking thing about the yields shown in Table 1 is that the heavy gas oil is an excellent catalytic cracking feed stock; actually it is better in many cases than the lighter gas oil boiling between heating oil and atmospheric bottoms. It is also noteworthy that the heavy pitch can be visbroken successfully and that a substantial saving in fluxing stock can thereby be achieved.

The effects upon over-all refinery yields will be discussed below. However, a good indication of these effects can be obtained merely by a consideration of the yields in Table 2, even though these are unfinished products obtained directly from the processing units. Thus a substantial increase in gasoline production would be anticipated from the upgrading of heavy gas oil from reduced crude cracking to catalytic cracking.



Flow scheme of the vacuum unit for processing reduced crude.

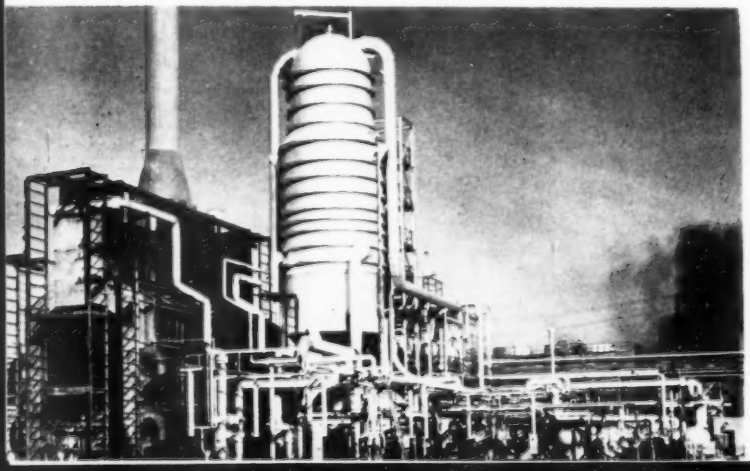
TABLE 1—INITIAL YIELDS OBTAINED FROM ATMOSPHERIC AND VACUUM CRUDE DISTILLATION

Crude—	West Texas		South Louisiana	
Gravity, A.P.I.—	32.0		37.0	
Crude distillation—	Atm. only	Atm. and vac.	Atm. only	Atm. and vac.
Yields—volume per cent on crude:				
Dry gas	0.6	0.6	0.4	0.4
Light naphtha—C. to 225 F.	9.7	9.7	8.9	8.9
Heavy naphtha—225 to 325 F.			9.0	9.0
Heavy naphtha—225 to 375 F.	16.5	16.5		
Kerosine—325 to 530 F.			28.7	28.7
Heating oil—375 to 650 F.	28.2	28.2		
Light gas oil—into 830	16.7	16.7	35.5	35.5
Heavy gas oil—830 to pitch		16.4		14.5
Residuum or pitch	28.3	11.9	17.5	3.0
Total	100.0	100.0	100.0	100.0

Over-all Yields from Crude

Table 3 shows the effect of vacuum distillation on refinery yields. Finished yields together with octane numbers for the motor gasoline are shown for the two crudes in the table in parallel columns to facilitate comparison between the atmospheric and vacuum distillation operation. Furthermore, in each case two sets of yields are shown illustrating both the maximum and an intermediate production of heating-oil fractions from the crude. If it were desired to reduce heating-oil production still further, this could be accomplished by employing additional cracking capacity to crack up these fractions; and the lighter cycle stocks could be recycled to extinction. If the refinery were operated in this manner, producing only gasoline and fuel oil, a considerably higher gasoline yield would be obtained than is indicated in the table.

Fired heater and fractionator of the vacuum unit at Baton Rouge.



Reforming for Octane Number

To exhibit clearly the effect of vacuum distillation on the octane number of the entire refinery gasoline pool, the processing summarized in Table 3 was set up in the following manner: In the vacuum distillation cases, the entire straightrun-naphtha cut boiling in the motor-gasoline range was blended directly into motor gasoline, and no reforming was employed. The resulting octane numbers for the two crudes are shown in the table, both clear and containing 1.5 cc. TEL per gallon. In the cases containing only atmospheric crude distillation we assumed that a heavy straightrun-naphtha cut would be reformed at an intensity sufficient to equal the same octane numbers. It is noteworthy that the combination of vacuum distillation and catalytic

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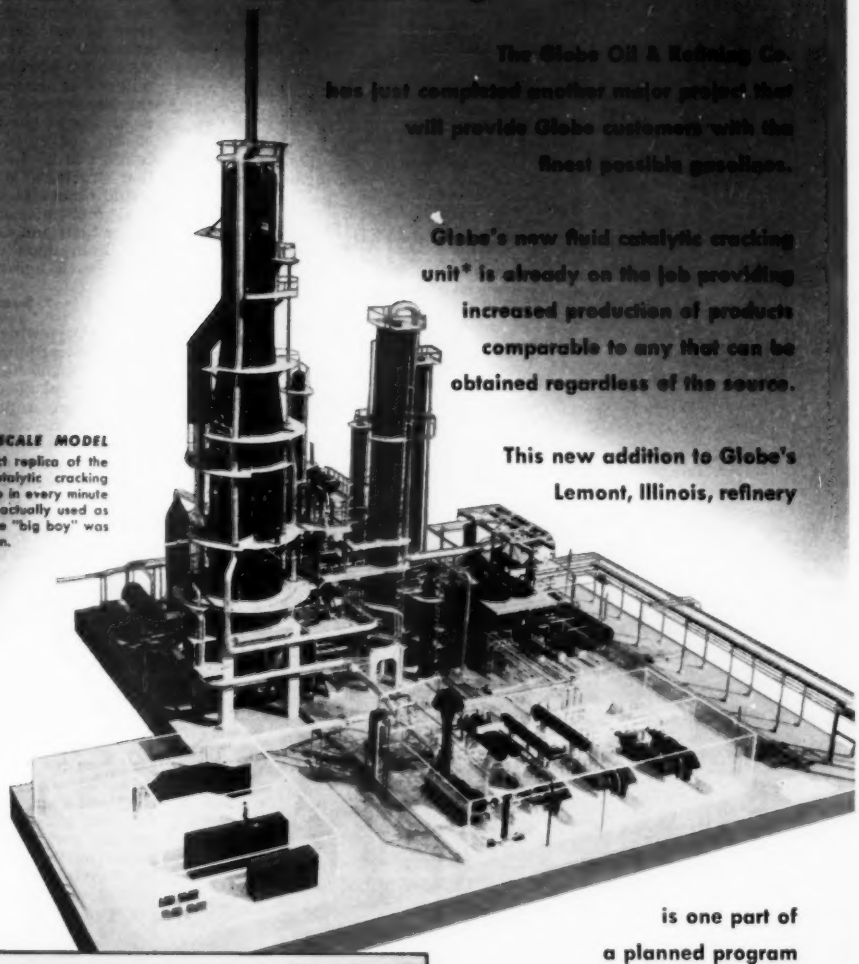

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cracking of the heavy virgin gas oils yields a substantial improvement in octane number compared with the atmospheric operation and thereby effects a marked saving in the requirement for heavy-naphtha reforming. This, of course, contributes to the reduction in fuel yield and the increase in gasoline yield.

Effect on Fuel-Oil Production

Looking at the yields from the two crudes it will be noticed that a substantial reduction in fuel production has been accomplished by the vacuum equipment. This is accompanied by increases in yields of both gasoline and heating oil with the larger increase going to gasoline. The effect upon fuel-oil yield is rather sensitive to the type of fuel-oil flux used. In this study the tars from thermal cracking were fluxed to Bunker C fuel-oil specification viscosity using the heavy gas-oil sidestream from the catalytic cracking unit fractionator. Other calculations have shown that vacuum distillation may bring about a greater reduction in fuel-oil yield when lighter fluxing stocks are available.

The effect on yields is significant from the standpoint of crude conservation. Vacuum distillation means higher yields of the lighter and more valuable products, namely, motor fuel and light burning oils. In the present state of our development of energy utilization we have no adequate substitute for petroleum motor fuel; and millions of homeowners who are the satisfied owners of oil-heating equipment would not like to be deprived of the convenience, cleanliness, and comfort of oil heating. To the extent that fractions of crude oil which would otherwise be burned as industrial fuel oil can be converted to motor fuels and distillate heating oils, the drain upon our domestic crude resources is less rapid.

TABLE 2—YIELDS FROM GAS OIL AND RESIDUUM CRACKING

Source of cracking feed stock—	Atmospheric distillation				Vacuum distillation	
Cut range of feed to cracking, °F.	430–650	530–650	650–830	830 +	650–1,100	1,100 +
Type of cracking—	catalytic	catalytic	catalytic	thermal	catalytic	thermal
West Texas crude:						
Yields:						
Dry gas, wt. per cent	5.3		7.3	1.4	8.3	1.4
C_4=, vol. per cent	3.4		4.9		7.7	
C_4, vol. per cent	5.1		4.4	11.4	4.7	10.0
C_5 + 430° F., vol. per cent	35.2		47.9		50.2	
430–650° F., vol. per cent	51.4		26.8	4.5	23.9	90.8
650° + F., vol. per cent	2.2		12.7	84.0	9.0	
Inspections:						
C_5 to 430° F. V.T. gasoline:						
R.v.p.	18.2		16.8	11.0	19.3	11.0
Octane No., clear	95.3		95.8	76.9	94.1	69.7
Octane No., +1.5 cc.	99.8		98.9	82.8	97.4	75.8
Tar viscosity, S.S.F. at 122° F.				220		1,300
South Louisiana crude:						
Yields:						
Dry gas, wt. per cent		6.3	7.8	1.3	9.9	1.4
C_4=, vol. per cent		4.5	5.8		10.6	
C_4, vol. per cent		6.1	4.8	11.1	5.5	10.0
C_5 + 430° F., vol. per cent		33.4	46.4		47.5	
430–650° F., vol. per cent		50.0	26.7	4.5	22.6	90.8
650° + F., vol. per cent		2.1	12.4	84.3	7.8	
Inspections:						
C_5 to 430° F. V.T. gasoline:						
R.v.p.		21.6	18.7	11.0	23.4	11.0
Octane No., clear		93.2	96.0	73.5	94.8	69.7
Octane No., +1.5 cc.		98.9	99.8	82.0	98.7	75.8
Tar viscosity, S.S.F. at 122° F.				130		1,300

TABLE 3—OVER-ALL REFINERY YIELDS OF FINISHED PRODUCTS PROCESSING TYPICAL DOMESTIC CRUDES AND FUEL PRODUCTS

	West Texas crude 32.0° A.P.I.		South Louisiana crude 37.0° A.P.I.	
Crude distillation—	Atm. only	Atm. and vac.	Atm. only	Atm. and vac.
1 Maximum heating-oil yield:				
Yields, vol. per cent:				
Gasoline	37.9	48.3	26.6	30.2
Kerosine			28.7	28.7
Heating oil	33.8	34.2	26.2	32.0
Net fuel oil	23.0	13.2	12.9	4.4
Total	94.7	95.7	94.4	95.3
Gasoline quality:				
C.F.R.R. O.N., clear	78.3	78.3	85.3	85.3
C.F.R.R. O.N., 1.5 cc. TEL gal.	86.5	86.5	91.2	91.2
Heavy-naphtha reforming:				
Feed to reforming, vol. per cent on crude	21.0		9.0	
Yield of C_5 to 430° F. V.T., vol. per cent	93.0		95.8	
2 Intermediate heating-oil yield:				
Yields, vol. per cent:				
Gasoline	49.9	59.5	34.2	39.4
Kerosine			28.7	28.7
Heating oil	22.4	21.4	18.4	20.7
Net fuel oil	21.7	13.6	12.3	5.1
Total	94.0	94.5	93.6	93.9
Gasoline quality:				
C.F.R.R. O.N., clear	80.0	80.0	85.8	85.8
C.F.R.R. O.N., 1.5 cc. TEL gal.	87.7	87.7	91.6	91.6
Heavy-naphtha reforming:				
Feed to reforming, vol. per cent on crude	21.0		9.0	
Yield of C_5 to 430° F. V.T., vol. per cent	88.0		87.6	

Summary

When reviewing the major developments in refining technology which have brought us from the simple skimming plant of 40 years ago to the complete refinery of today, it is clear that the combination of vacuum distillation, vis-breaking, and catalytic cracking is one of the principle forward strides in obtaining more valuable products from crude. From the standpoint of the individual refiner who has built or is considering building vacuum distillation equipment, this processing combination has the following attractive features:

1. It will improve profits, since less-valuable fuel oil is converted to more-valuable heating oil and gasoline by processes which have been demonstrated to be practical and economically attractive.

2. The refiner with vacuum distillation has greater flexibility in operating his refinery than one who does not. With vacuum distillation any time there is a greater demand for fuel oils at attractive prices it can be met by either temporarily bypassing the vacuum distillation or by stepping up crude runs and not cutting as deeply into the crude.

3. The higher octanes obtained by the refiner who installs vacuum distillation and catalytic cracking enable him to keep up with his competition in meeting today's demands for higher-octane motor fuels.

The factors listed above, of course, can be said to apply to industry generally as well as to the individual refiner. In addition, there are other reasons why the refining industry would benefit from the wider adoption of vacuum distillation. The flexibility spoken of keeps the refining industry in a better position to meet the changing market demands for various products and thereby helps preserve more stable conditions in the industry.

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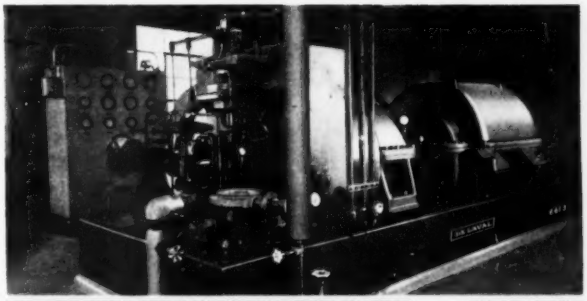
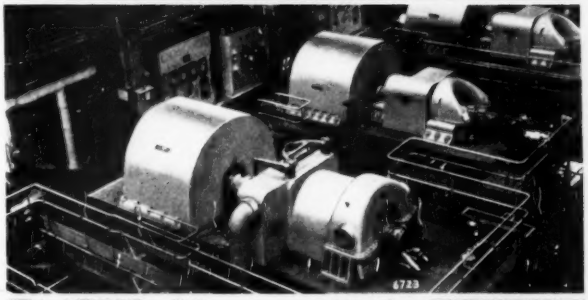


IN REFINERIES

This 1910 hp, 17,800 cfm De Laval Turbine Driven Blower supplies air for catalyst regeneration in a fluid catalytic cracking plant.



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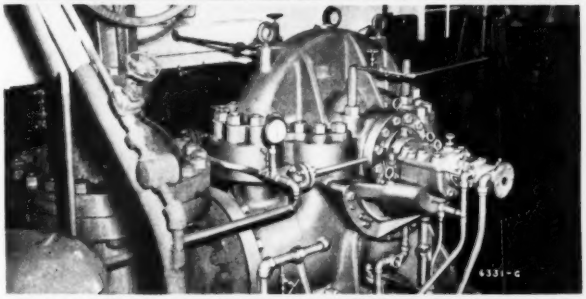

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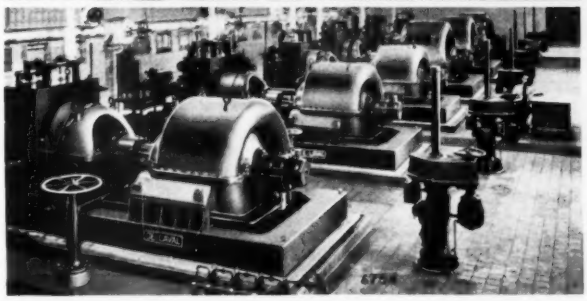

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Plant Supervisors Administer Effective Safety Program

. . . at Pan American Refinery

by G. M. Dent*

FOURTEEN months ago the management of Pan American Refining Corp. at Texas City, Tex., came to the conclusion that safety was not reaching the men down the line, that too much responsibility rested upon the safety and fire-protection department which, with three men, was endeavoring by a direct approach to make 2,000 employes safety conscious. Having reached that conclusion, a comprehensive study of the problem culminated in the program now in effect which has as its slogan—"Safety Is Your Business."

This program is designed to inculate the supervisor with safety and through him to reach the workers without burdening the supervisor with meetings and other similar demands upon his time. Thus, instead of three men from the safety and fire-protection department endeavoring to promulgate safe practices and conditions, there are now 145 refinery supervisors doing this on an around-the-clock basis.

One year is not sufficient time to evaluate the benefits of the program; nevertheless, the results achieved thus far and the favorable reaction

*Assistant general superintendent, Pan American Refining Corp., Texas City, Tex.

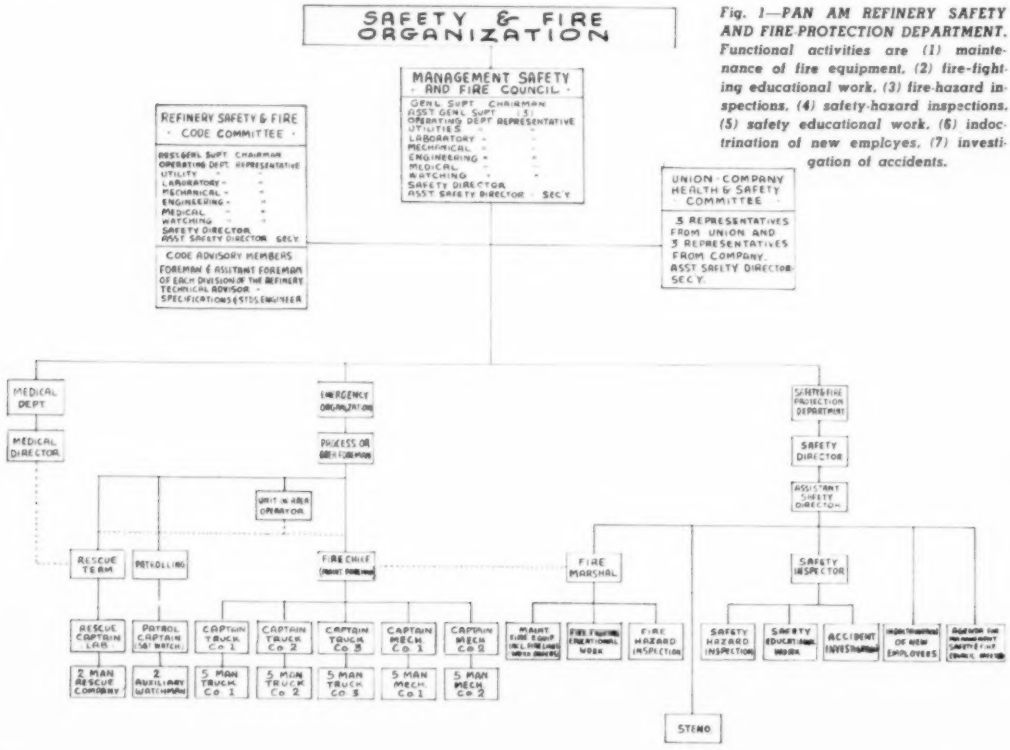

Fig. 1—PAN AM REFINERY SAFETY AND FIRE-PROTECTION DEPARTMENT. Functional activities are (1) maintenance of fire equipment, (2) fire-fighting educational work, (3) fire-hazard inspections, (4) safety-hazard inspections, (5) safety educational work, (6) indoctrination of new employes, (7) investigation of accidents.

of the employes, indicate that it is a satisfactory approach to the refinery's safety problem.

Basic Features of Program

In the current safety program the first line supervisor is the key man. He receives a constant flow of written information on safe practices, potential hazards, accident investigations, and other matters conducive to safety mindfulness. This material is designed for easy reading and dissemination to the workers. It is all "local" in color, in order that reader interest will be of the highest order. No "canned" advertising, posters, or other mass-produced materials are used. By drawing on local experiences the information has a greater meaning to the supervisor and it is easy for him to utilize it in the job instructions.

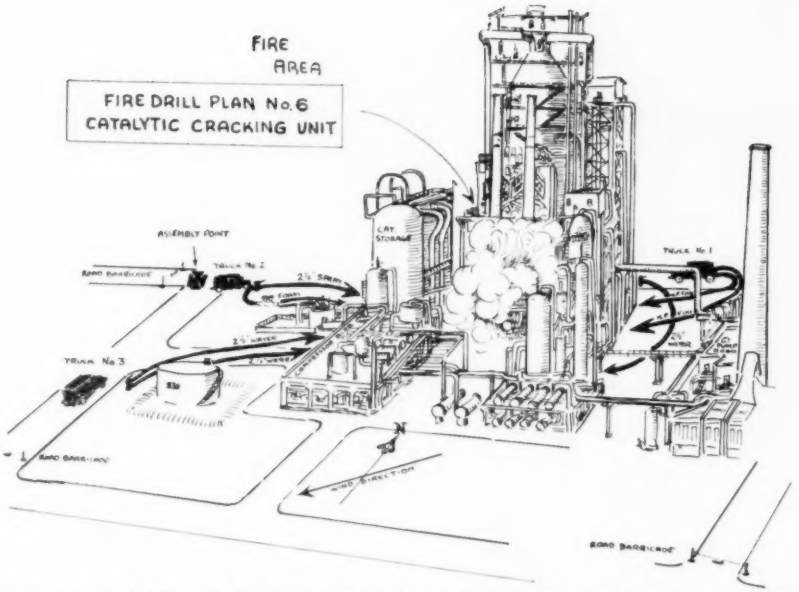

Fig. 2—A typical drill at one of Pan American Refining's units; location is the refinery's catalytic cracking unit.

The safety and fire-protection department carries on only staff functions. These include accident investigations, fire and accident-prevention inspections, fire and accident educational work, indoctrination of new employes, and other similar work.

A special feature of the safety program is the emergency organization. It consists of fire-fighting companies, mechanical companies, a rescue team, and a patrol squad. The personnel is composed of regular employes on duty; consequently, the emergency organization is available 24 hours a day, 7 days a week. The over-all safety and fire organization of the Texas City refinery is illustrated by the accompanying chart.

Management safety and fire council.—Membership of the council consists of the general superintendent (chairman), the three assistant general superintendents, the medical director, the safety director, and one representative each from the operating, utilities, laboratory, mechanical, engineering, and plant-protection departments. The assistant safety director is the secretary.

The functions of the council are: (1) to review and set upon recommendations of the safety director, the union-company health and safety committee, and the refinery safety and fire-code committee; and (2) to initiate programs and practices which will be conducive to a high level of safety.

The council meets at least once each month, and at other times as called by the chairman. A copy of the minutes is furnished to all supervisors.

Refinery safety and fire-code committee.—Membership of this committee consists of the assistant general superintendent - mechanical (chairman), and the members of the management safety and fire council, except the general superintendent and the other assistant general superintendents. The foreman and assistant foremen serve as advisory members of the code committee. The assistant safety director is the secretary. The specifications and standards engineer, of the engineering design and development department, is the technical advisor to the committee.

The function of the code committee is to prepare safety and fire-prevention codes for the approval of the management safety and fire council. These codes are released to all supervisors and the workers are advised of the existence of the codes by bulletins which are posted throughout the plant.

Union-company health and safety committee.—The contract with the union provides that there shall be a health and safety committee composed of six members (three selected by the union and three selected by the company) which shall meet each month for the purpose of discussing matters pertaining to health and safety. This committee considers safety and health matters which presumably received no attention at the departmental level, and makes recommendations to the company regarding matters within its jurisdiction.

The company representatives on the union-company health and safety committee are members of the management safety and fire council. Consequently, there is a direct connection between the company representatives on the health and safety committee and the council. This makes it possible to pursue investigations promptly and to take appropriate measures when these are necessary. It is the consensus that this phase of the council's work is having a satisfactory effect on the company's industrial relations.

The proceedings of the union-company health and safety committee are attached to the council minutes which are distributed to the supervisors. In this way the supervisors are informed of the complaints being made and what disposition is made of them.

Safety and fire-protection department.—This department, as stated previously, carries on only functional activities. As shown in Fig. 1 the functions of the department are mainly:

1. Maintenance of fire equipment including fire lines (work orders).
2. Fire-fighting educational work (equipment and techniques).
3. Fire-hazard inspections (housekeeping).
4. Safety-hazard inspections (tripping and stumbling hazards, guards, protective equipment, etc.).
5. Safety educational work (causes and prevention of accidents, posters, properties of chemicals, petroleum, etc.).
6. Indoctrination of new employes.
7. Investigation of accidents.

Emergency organization.—This organization is one of the important parts of the safety program. During

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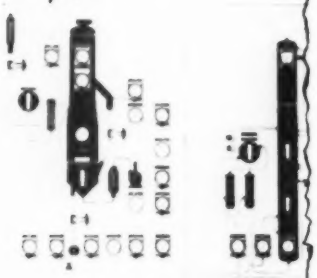

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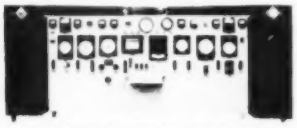

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an emergency, it is under the jurisdiction of the process (or area) foreman who is responsible for the fire-fighting, rescuing, and patrolling operations, unless relieved by a member of management on a higher level.

The fire chief (shift maintenance foreman) directs the activities of the three truck companies and two mechanical companies. The members of these companies consist of available personnel from various plant departments.

The patrol captain (sergeant of plant-protection department) with two men (or more if necessary) directs all policing activities by setting and maintaining barricades. Only authorized persons are admitted to the emergency area.

The rescue captain (laboratory technician), with two men, directs rescue operations, including resuscitation, application of tourniquets, handling of stretchers, removal of persons overcome by fumes or toxic gases, etc. The training of the rescue squad is under the direction of the medical director, assisted by the safety inspector (the latter with reference to the use of safety equipment, such as asbestos suits and fresh-air masks).

Training of the emergency organization is done under simulated conditions. A problem, developed by the safety department in cooperation with the operating supervisory staff, is presented to the council for approval. Thereafter, the fire marshal reviews the problem with the area (or process) supervisor and the fire chief, and a set of drills is planned so that all men at the facility selected for the simulated fire may have a chance to participate in the drill.

A typical drill at one of the refinery's units is illustrated by fire-drill plan No. 6. Location is the refinery's catalytic cracking unit, see accompanying figure.

Typical Fire-Drill Plan

A flanged joint in an oil line operating at approximately 600 F. has failed at the bottom of one of the C-5 feed preheat exchangers near the southwest corner of the second level of the main tower structure. The hot oil has flashed and spread, endangering vital control equipment on the second deck and the tower group structural members on the ground level.

The wind direction is from northeast to southwest, fanning flames into the north end of the compressor building.

The nature of the fire requires removal of fuel for extinguishment at the point of origin, and in addition the spill fire on the pavement must be extinguished by the use of foam while structure and operating equipment must be protected.

During these operations extreme care must be exercised to avoid directing streams of foam, fog, or solid water against the regenerator stand-

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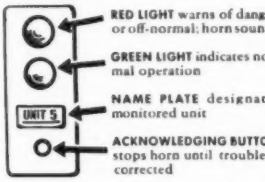
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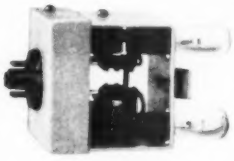

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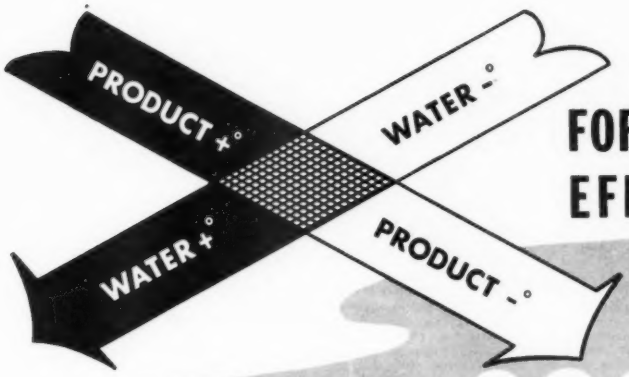

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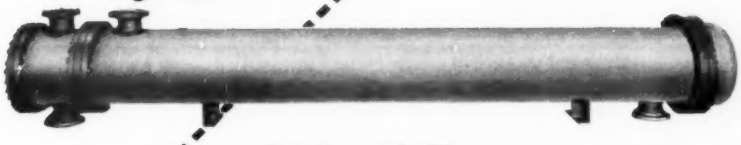

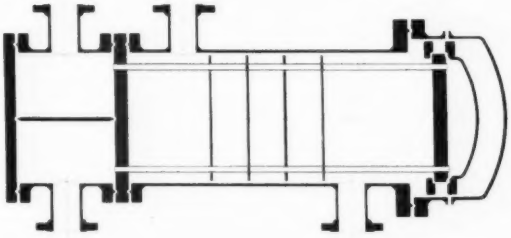

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pipe and control valves located in the north half of the tower structure.

At the appointed time the emergency organization shall leave the fire house with the three trucks, proceed northward on the main street and turn eastward at the knock laboratory intersection. The point of assembly for instructions will be at the first street east of the laboratory.

It shall be assumed that an operator has slipped on the stairs at the northeast corner of the structure, and sustained a severe laceration of the left arm and possible fracture of the right leg.

Area Supervisor's Instructions to Rescue Captain

1. Administer emergency first aid and transport injured man at northeast corner of the structure to a point of safety northeast of unit. Contact the patrol car and request that the main gate be notified by radio to send the ambulance to the north side of the catalytic cracking unit to transport the injured employe to the medical department.

Area Supervisor's Instructions to Fire Chief

1. Apply foam to the spill fire on the ground level from a position northwest of the fire.

2. Apply water spray to the fire on the second level from a position north of the fire by laying a $2^1/_2$-in. line up the stairs at the northwest corner of the main tower.

3. Apply high-pressure fog to the fire on the second level by laying two high-pressure lines up the stairway at the northwest corner of the main tower and permitting the fog to travel into the fire on the prevailing wind.

4. Lay one $2^1/_2$-in. line with combination fog and straight stream nozzle from a fire connection at the northeast corner of the main tower, between the tower and pump room so the stream can be used to control the spread of fire toward the pumps and other operating areas.

5. Apply streams with combination fog and straight stream nozzles to the control valves at the southwest corner of the tower between the second and third levels by bringing two $2^1/_2$-in. lines in from the west.

6. Avoid directing any streams against the regenerator standpipe or valve in the north part of the tower.

7. Patrol sergeant.—Barricade the streets at the four corners of the catalytic cracking battery limits.

Fire Chief's Instructions to Captains

1. Truck company No. 2.—Connect two $2^1/_2$-in. lines to the hydrant northwest of the catalyst storage. Connect one to a generator and deluge set and apply foam to the ground fire from the northwest.

2. Mechanical company No. 1.—Assist truck company No. 2 in connecting $2^1/_2$-in. line to hydrant and take the second line connected to this hydrant up the stairs at the northwest corner of the tower and direct the spray into the main fire on the second level.

3. Truck company No. 1.—Proceed to the northeast corner of the tower, take both high-pressure lines up to the second level and apply fog into the main fire area from the northeast. Lay one $2^1/_2$-in. line from the connection at ground level at the northeast corner of the tower, between the tower and pump room and apply a solid stream into the main fire area on the second level. If the ground fire spreads toward the pump room or compressor building, control the spread with spray. Avoid washing out the foam blanket being applied by company No. 2.

4. Truck company No. 3.—Lay two $2^1/_2$-in. lines from the hydrant west of tank No. 230 to apply spray or solid streams to protect control valves on the second level at the southwest corner of the tower, the compressors and other equipment adjacent to the fire.

5. Mechanical company No. 2.—Report to the stillman and assist with shutting down the unit.

Simulated fire drills are planned for each major refinery facility. In this way all operating personnel have a chance to participate in the fire drills and the emergency organization is trained for the conditions that may be encountered at various locations throughout the refinery.

The response to the emergency organization has been very enthusiastic. Occasionally the emergency organization trains with the actual extinguishment of fires. However, it is the consensus that the simulated fire drills are more effective for training purposes.

While Pan American's safety record has always compared favorably with that of the refining industry generally, it is the company's objective to reduce accidents to the minimum. During the year 1949, which was the first year under the new program, lost-time accidents per million man-hours worked decreased to 69 per cent of the number experienced during the year 1948. It is anticipated that the record will be improved as the full effects of the present program are obtained.

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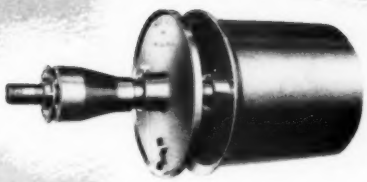

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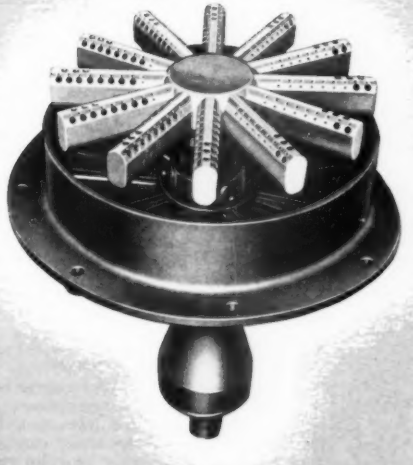

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Propylene Polymerization for Motor-Gasoline Production

by Wendell F. Deeter

PRIOR to World War II, Richfield Oil Corp. installed a Universal Oil Products Co. polymerization unit for the copolymerization of propylene and butylenes. Operation on this mixed feed was excellent from the standpoint of catalyst life, propylene conversion, and over-all conversion. Early in the war period all butylenes were diverted to alkylation and the polymerization unit was then operated for a short time on propylene polymerization before being converted to the manufacture of cumene.

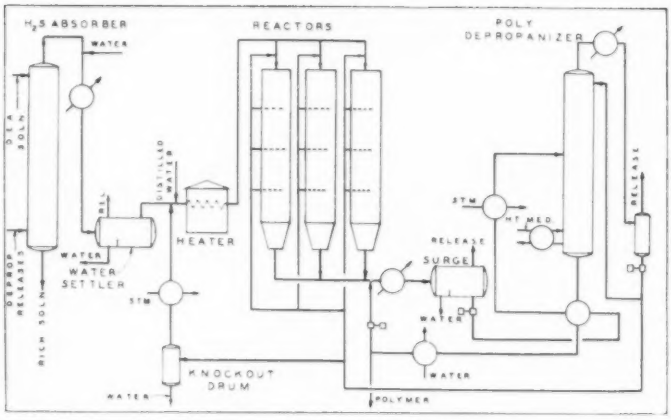
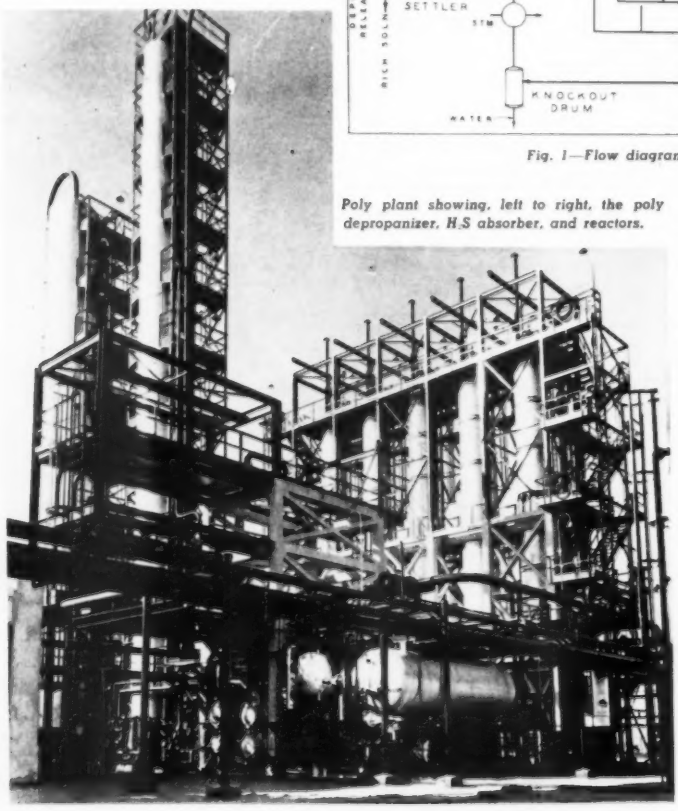


Fig. 1—Flow diagram of the poly plant.



Poly plant showing, left to right, the poly depropanizer, H_2S absorber, and reactors.

Production of cumene was discontinued immediately upon the termination of hostilities and the unit then remained idle until 1947 when propylene polymerization was resumed. As a result of several plant changes and closer control of operating variables, a profitable operation was eventually established. The unit is currently producing approximately 350 bbl. per day of polymer at an average conversion of 80 per cent and a catalyst life of around 35 gal. of polymer per pound of catalyst.

Unit Changes

The unit originally contained five 4-ft.-diameter catalyst towers or reactors, a gas-fired feed-stock heater, a product depropanizer, catalyst regeneration facilities, plus the requisite auxiliaries. The catalyst towers were connected in series with top to bottom flow through each reactor. Each tower contained two 16-ft. beds of U.O.P., Type 1, solid phosphoric acid catalyst, totaling 20,800 lb.

The catalyst towers have been reconnected for parallel flow with the direction of flow remaining unchanged. Additional catalyst support gratings have been installed increasing the number of beds per tower

The author is process engineer for Richfield Oil Corp., Los Angeles, with which company he has been associated for 12 years. He is a graduate of University of California, where he received a B. A. degree in chemistry in 1937. A native of Kansas, he received his elementary education in that state and in Connecticut.

from two to four. Total quantity of catalyst charged was reduced to 19,600 lb. Quench sprays were installed above each of the three lower beds and a quench connection made in the feed line near the point of entry.

Catalyst in the bottom bed is supported by a cone which is removed from the bottom of the reactor. The other three beds are each supported by a pair of grates, hinged in the center, and held in position by pins which are removed from the outside of the reactor.

The catalyst towers were connected in parallel for the purpose of providing greater flexibility of operation and to overcome some of the difficulties experienced with series flow. With parallel operation, it is possible to take a tower out of service at any time. Also, maximum throughput can be handled at one-third the velocity.

The catalyst was divided into four beds for two reasons. First, it is easier to control the operating temperatures of four shallow beds than those of two deep beds. It is possible through variation of bed depth, coupled with the use of recycle and quench, to control the maximum temperature in a bed and to a certain extent the temperature spread across the bed. This point is important since maintenance of the proper state of catalyst hydration during operation is a function of temperature. Also, polymerization at a high-temperature level tends to increase the amount of polymer boiling above the gasoline end point. Second, it reduces the load on the catalyst in the bottom part of each bed. Consequently, there is less tendency toward pellet distortion and plugging of soft catalyst. Table 1 shows the weight on the catalyst at the bottom of each bed for two and four-bed towers.

Flow and Operating Conditions

The virgin feed is a mixture of depropanizer release gases from thermal and catalytic cracking operations. A total of 2,850 M.c.f. is processed per stream day. Propylene content of the virgin feed is 34 mol per cent. The combined gases contain 5.3 mol per cent H_2S which is first removed by a Girbotol unit using diethanolamine solution. The Girbotol absorber operates at 250 psig. and removes 99.3 per cent of the H_2S.

Water is added to the gas leaving the absorber and the mixture passed through an exchanger into a water settler. Exhaust steam is used on the exchanger to maintain the temperature of the water settler at 105° F. The settler conditions are held above the dew point of the feed to prevent condensation and to insure saturation with water. Approximately 55 per cent of the catalyst water requirement is added at this point.

Recycle and quench streams are taken as a liquid from the poly depropanizer overhead accumulator. The recycle passes through a water knockout drum, is preheated by steam, and then joins the virgin feed before entering the gas-fired, feed-stock heater. Distilled water is added to bring the water content of the combined feed up to the required percentage. The temperature of the total feed is raised by the heater from 130 to 400 F. before entering the catalyst towers. The propylene content of the combined feed will average 30 mol per cent.

Three catalyst towers are operated while the fourth is either being regenerated or is standing by. The feed is divided evenly among the three towers unless the catalyst in one is partially plugged. The average throughput, including recycle, for normal operation is 1,100 M.c.f. per stream day per tower, which corresponds to a space velocity of 0.062 gal. per hour per pound of catalyst.

The catalyst towers operate at the maximum pressure obtainable, usually 240 psig. The exothermic temperature rise is controlled by the use of quench and recycle to hold a maximum of 450 F. in the lower part of each catalyst bed. Quench is used for controlling temperatures in the second, third, and bottom beds. Recycle, plus quench in some cases, is used for controlling temperatures in the top bed. Hancock valves, with graduated scales showing valve position, are used to regulate the amount of quench to each bed. A meter on the total quench to all beds is used in determining the amount of quench added or withdrawn for a given change. Thermocouples are located at the top and bottom of each catalyst bed and the temperatures at these points are continuously recorded.

The reactor effluent passes through water-cooled condensers into a surge drum. Noncondensed gas is released to fuel. Bottoms from the depropanizer are recirculated through the condenser to hold the quantity of release to a minimum. The surge normally operates at a pressure of 235 psig. In case of plugged catalyst towers, the surge pressure may be reduced to as low as 220 psig.

Liquid from the surge is charged to the poly depropanizer. The tower contains 30 trays and is operated at 250-psig. pressure to produce an essentially isobutane-free overhead. The overhead release is either put to fuel or deethanized for L.P.G. production. Recycle and quench are taken as liquid from the overhead receiver. The bottoms contain 2.5 per cent propane and have a Reid vapor pressure of 10 lb. Heat medium from the thermal cracking units is used in the kettle. A flow diagram of the unit is shown in Fig. 1.

Samples of the virgin feed, recycle, and release gases are taken for mass-spectrometer analyses and used in determining the over-all plant conversion. In addition, samples are periodically taken of the individual reactor effluents for determining the conversion of each reactor.

Polymer Quality

The polymerization of propylene produces a gasoline with high octane values and sensitivity. The neat F-2 octane is 81 and the F-1 94.6. Blending octanes are appreciably higher than these values. Depending upon the type of stock with which it is blended, the neat motor method blending values will vary from 84 to 93. The corresponding research blending values will fall between 97 and 102.

The boiling points of the polymer are higher than gasoline specifications allow but can be blended off when used in small percentages with other stocks. The inspection of a

TABLE 1

No. of beds—	2		4	
Bed—	Ft. of catalyst in bed	Weight on catalyst at bottom of bed (psi.)	Ft. of catalyst in bed	Weight on catalyst at bottom of bed (psi.)
Top	16	5.7	6½	2.2
Second			7½	2.5
Third			8½	2.9
Bottom	16	5.7	9	3.0

TABLE 2—PROPYLENE POLYMER INSPECTION

Gravity	61.9
I.b.p.	98
5 per cent	176
10 per cent	208
20 per cent	236
30 per cent	252
40 per cent	268
50 per cent	280
60 per cent	292
70 per cent	310
80 per cent	336
90 per cent	380
E.p.	438
Rec.	94.5
R.v.p.	10.0
Sulfur—weight per cent	.05
Bromine No.	125.4
A.S.T.M. gum	4.6
Induction period, min.	70
Octanes:	
F-1 + 0 cc. TEL	94.6
+ 3 cc. TEL	98.9
F-2 + 0 cc. TEL	81.0
+ 3 cc. TEL	85.4

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typical propylene polymer is shown in Table 2.

Catalyst Regeneration

During operation, carbonaceous material is deposited on the catalyst. The amount deposited is a direct function of the amount of polymer produced. The deposition of this material causes the conversion to decline until it is no longer economical to keep the tower in service. When this point is reached, the tower is taken out for regeneration.

The tower is first purged with flue gas to sweep out all light hydrocarbon. Following the purging, flue gas at a temperature of 550° F. is passed through the tower for a period of 24 hours to distill and remove volatile hydrocarbons remaining on the catalyst. This operation reduces both the length and severity of the burning cycle. After the "distillation" period, a small amount of air is added to the flue gas to initiate combustion. Oxygen content of the flue gas is gradually increased until 16 per cent is reached, at which point burning is virtually complete. The rate of excess air addition is regulated to maintain even burning temperatures throughout the beds and to prevent, insofar as is possible, sudden rises or "takeoffs." The towers are burned at temperatures below 900° F. to minimize the loss of phosphoric acid.

During the burning operation, water of hydration is removed from the phosphoric acid. This water is replaced during the hydration phase of the regeneration cycle. At the completion of the burning operation, the tower is cooled until catalyst temperatures are lined out in the 500°-600° F. range. Steam, superheated to 550° F. and at atmospheric pressure, is passed through the reactor at the rate of 1,000 lb. per hour for a period of 8 hours. During hydration, 550° F. flue gas is put through the jacket of the tower to maintain catalyst temperatures above 500° F. Following hydration, the tower is either put in service or left in standby condition. The direction of flow for regeneration is the same as in operation.

Table 3 shows laboratory tests of typical polymerization catalyst when new, before burning, and after burning and hydration. The weight per cent free P_2O_5 is a measure of both the initial activity of the catalyst and the ability of the catalyst to maintain activity during operation. The sulfur and nitrogen analyses indicate the presence of contaminants or poisoning agents. These samples of catalyst were taken from the same location in the tower—at the top of the bottom bed.

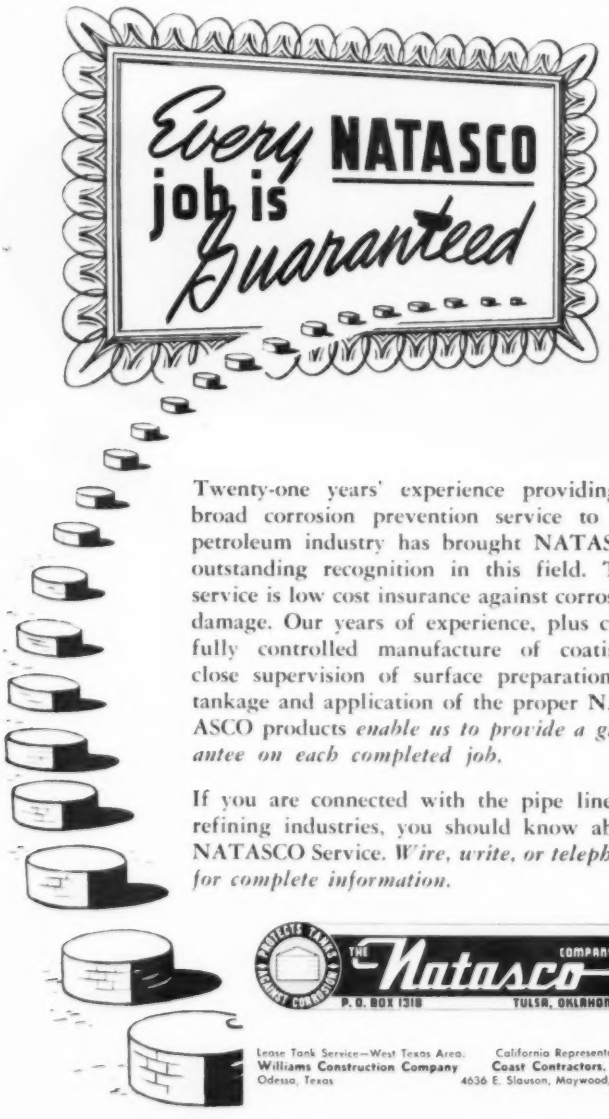
TABLE 3

	New	Before burning	After burning and hydration
Free P_2O_5—Wt. %	19.0	15.4	22.4
Total P_2O_5—Wt. %	62.5	54.6	59.9
% Carbon—Wt. %	0.03	7.5	0.43
% Sulfur—Wt. %	0.0	0.0	0.0
% Nitrogen—Wt. %	0.013	0.027	0.01

Catalyst Removal and Recharging

If there is an appreciable pressure drop through the catalyst, or the activity is too low to justify another operating cycle, the catalyst is removed following the burning operation. Starting at the bottom, the beds are removed one at a time by pressuring out with steam. The bottom catalyst support is removed and steam admitted through the quench connection just above the top of the bed. The softening effect of the steam coupled with the pressure (not in excess of 20 psig.), plus the weight of the catalyst is sufficient to remove the catalyst within a period of time ranging from a few minutes to several hours. A minimum temperature of 300° F. is maintained during the operation.

The use of steam pressure for catalyst removal is quick and economical. The actual operation of removing the catalyst is performed by the



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After the catalyst has been removed, the towers are inspected, repaired and recharged. The bottom supporting cone is replaced and the conical lower section of the tower filled with crushed firebrick. The predetermined quantity of catalyst is charged. The operation is repeated for the top three beds.

Operating Problems

Since initiating propylene polymerization, efforts have been directed towards maximizing production by reducing the rate of conversion decline during operation and by eliminating those factors causing the development of pressure drop. Several general conclusions, concerning the effect of various operating variables, may be drawn from operations to date.

The level of conversion and the rate of conversion decline are both functions of the degree of catalyst hydration. Properly hydrated catalyst will show an initial conversion ranging from 90 to 95 per cent. The initial activity of under hydrated catalyst will be lower than this figure, the magnitude of the difference depending on the degree of under hydration.

The rate of activity decline is quite rapid for under hydrated catalyst. Towers containing properly hydrated catalyst have been operated for periods up to 60 days in length and have produced as high as 18 gal. of polymer per pound of catalyst during the cycle. Insufficiently hydrated catalyst can be operated for approximately half the normal time before the conversion has declined to the economic discard point. This rapid loss of activity is not due to excessive deposition of carbonaceous material since burning times for under hydrated towers are also approximately half the normal and are proportional to the amount of polymer produced.

To prevent loss of hydration during operation, the partial pressure of water in the combined feed is held equal to the partial pressure of water over phosphoric acid catalyst at the operating conditions. As previously mentioned, approximately 55 per cent of the required water is in the feed leaving the water settler and the balance is added as distilled water before the process heater. The water lost during burning is replaced by hydration. Insufficient time for the latter operation leaves a dry, inactive catalyst.

Phosphoric acid containing from 18 to 20 per cent by weight of free P_2O_5 can be classed as properly hydrated. The free P_2O_5 content is determined by the Universal Oil Products Co. method.*

The plugging of the catalyst, ac-

*Determination of phosphoric acid in polymerization catalyst; Method M-170-43-I.

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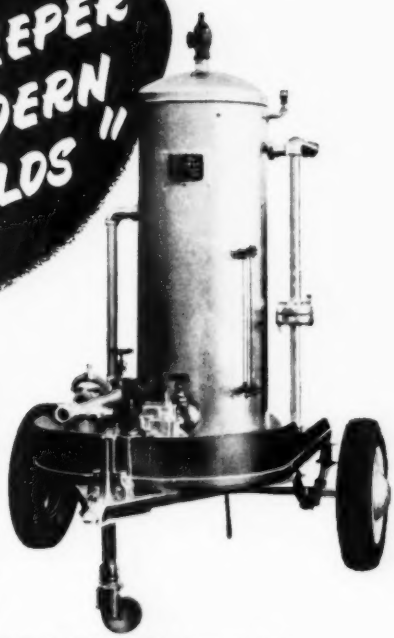

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companied by an increasing pressure drop across the reactor, is the factor largely responsible for determining the life of a particular batch of catalyst. The plugging is due to softening of the catalyst followed by distortion of the pellets with a reduction in the percentage voids. Pressure drop develops as the voids are restricted either by pellet distortion or by excessive carbon laydown. Pressure drops caused by the former are permanent; those due to the latter will largely disappear during regeneration.

Several steps have been taken to reduce catalyst softening and plugging. Water added to the feed is closely controlled, since an excess rapidly softens the catalyst. Also, the depths of individual beds have been more nearly equalized, which has reduced loading on the catalyst in the lower parts of the beds.

Plant operation has indicated that soft catalyst can be plugged by high throughputs. To prevent this, a sufficient number of reactors are operated to handle the total available feed at individual rates below the maximum.

During the burning phase of reactivation, the catalyst is partially dehydrated and pellet hardness restored. During hydration, the minimum temperatures are held above 500° F. to prevent softening.

A catalyst yield of about 35 gal. of polymer per pound of catalyst is currently being attained. The number of operating cycles range from two to four. As previously mentioned, eventual plugging of the catalyst is the factor determining the life of the catalyst.

Economic Benefits

There are several economic advantages for the polymerization of propylene. In the first place, material is upgraded from fuel to gasoline value. For every barrel of propylene consumed, approximately 0.7 bbl. of gasoline is produced. This should be particularly attractive in those regions with surplus gas and cheap fuel.

Second, it permits the burning of additional fuel oil in those plants which have a surplus of fuel oil and are either in balance or are short of fuel gas. Each barrel of propylene is equivalent in fuel value to 0.56 bbl. of fuel oil.

Third, propylene polymerization effects a saving in tetraethyl lead due to the high blending value of the polymer. The polymer is particularly valuable for raising research method octanes.

Fourth, the tail gas from the poly plant offers an additional source of propane for L.P.G. The H_2S has been removed and the propylene content reduced. The only step remaining is deethanization to meet vapor pressure specifications.

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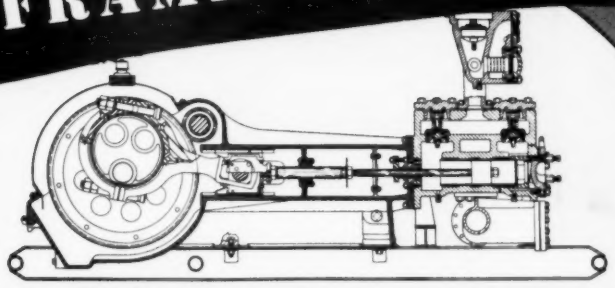

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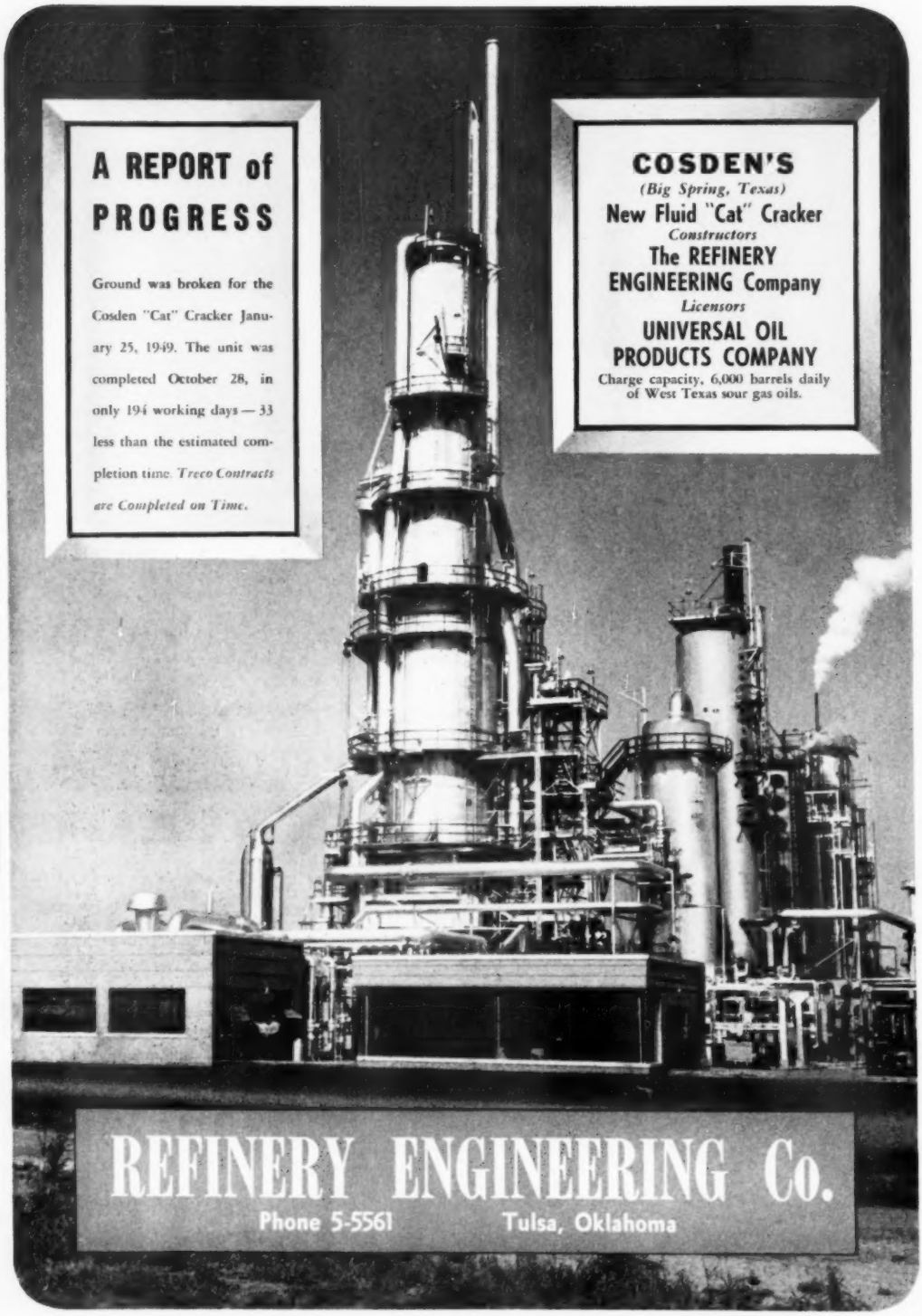
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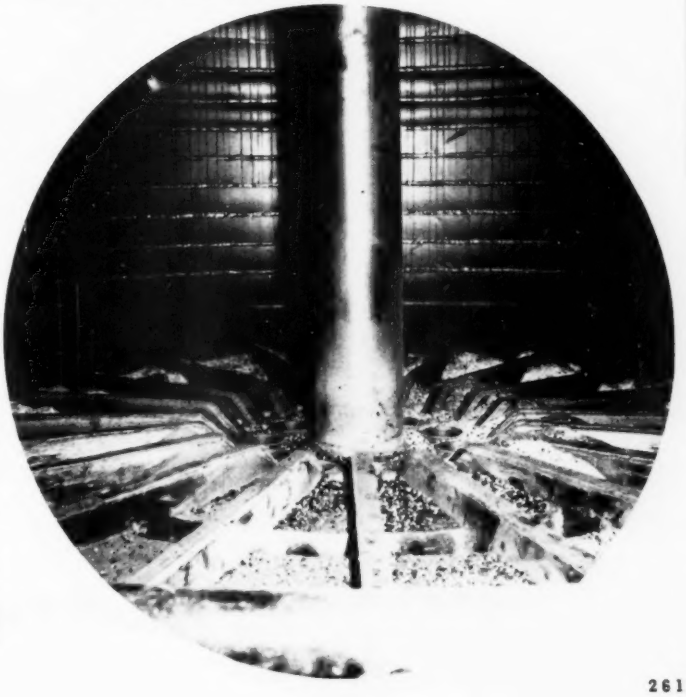
T.C.C. Unit TURNAROUND *after* Two Years' Operation

by Coy A. Hardcastle

Left: Lion Oil Co.'s Thermofor unit is now geared to operate on 6,000-bbl. daily fresh charge. Below: Distorted strip lining in reactor tower.

AFTER 2 years of experience in operating and maintaining a Thermofor catalytic cracking unit, Lion Oil Co. at El Dorado, Ark., finds it relatively routine to conduct an inspection and turnaround. The unit, which was among the first simplified postwar designs, was constructed for 4,500 bbl. per day of fresh gas-oil charging stock to the reactor, with 900 bbl. per day recycle. After operating for a year the fresh gas-oil charge to the reactor was increased to 6,000 bbl. per day. In spite of the fact that there has been down time for process changes for increased throughput, in addition to that for the regular scheduled cleanouts and inspections, the unit has been operated with an on-stream time of 94.6 per cent. To efficiently complete the work planned during the inspection and turnaround of the T.C.C. unit, it has been necessary to outline a procedure of operation which would coordinate all departments taking part. The function of each of these departments will be outlined here.



Engineering and inspection. — The engineering, mechanical, and operating departments start planning a turnaround many weeks before the unit is actually shut down. Items concerning major changes in design or altera-

The Author

Coy A. Hardcastle, plant engineer for the refining division of Lion Oil Co. at El Dorado, Ark., began his service with the company in 1936 after receiving a B.S. degree in chemical engineering from University of Arkansas. His activities have been varied, ranging from analytical chemist, efficiency engineer, chief inspector and process engineer, to his present position as plant engineer. His association with the T.C.C. unit began in the summer of 1946 when he served as resident engineer for Lion Oil Co. in New York, where the unit was being designed and the equipment purchased. Since the unit went into operation he has supervised the activities of the corrosion and inspection section of the engineering department, as well as other phases of the refinery engineering department.

tions to effect better operation are discussed in meetings of the plant manager, refinery superintendent, and all the department heads. During these meetings the time required for the shutdown is estimated and the major jobs which determine the length of shutdown are planned to avoid any possible delays in starting up.

Following the return of the unit to operation, the inspection department assembles all inspection data collected in the field and prepares a formal inspection report. This report summarizes all of the work completed with recommendations for future changes and improvements in the mechanical equipment. Numerous drawings are prepared showing the condition of all process and catalyst piping, as well as towers, drums, vessels, heat exchangers, furnaces, pumps, and instruments. This report is available to all department heads for use in reviewing the last turnaround and making plans for future turnarounds. The report actually serves as a guide for the engineering department in making a selection of replacement materials and equipment far in advance of the time they are needed.

Operating department.—When the turnaround date has been established, the operating department starts preparing the unit for the mechanical department about 18 hours before the actual mechanical work begins. The feed is cut back and the reactor is bypassed. All furnace fires are cut and the coils are steamed. The stripping steam in the reactor is allowed to purge the catalyst of hydrocarbon vapors. The catalyst is circulated until carbon content is burned to 0.05 per cent by weight. When the catalyst temperature drops to about 850° F. the kiln cooling coils are gradually taken out of service. When all coils are removed from service, the water-circulation system is shut down.

Eight hours after the unit has started down, all furnaces are blinded off for decoking and inspection. When all streams have been pumped to slop tanks, the fractionator and tar separator are alternately steamed and washed until they are gas free and cool enough to work on. All gasoline vessels are vented and steamed for 8 hours. By the time the mechanical department is scheduled to work, all vessels are gas free and cool enough to enter.

In addition to making the unit ready for the mechanical department, the operators are on duty at all times to assist the mechanical department in locating steam lines, air lines, and isolating sections of piping.

Mechanical department.—The length of a turnaround period is so closely tied in with refinery economics that it is necessary to plan and organize the turnaround for minimum off-stream time. The mechanical-department superintendent, after meeting with all of the craft foremen to discuss and plan the work to be undertaken during the turnaround, issues orders a few days before the shutdown to move in all the necessary construction equipment. Tubular metal scaffolding and sectional scaffolding are erected wherever possible so there will be no delay when the operators turn the unit over to the mechanical department. All replacement parts and materials that are scheduled for installation are moved into the unit area. Tools and equipment are made ready—such as welding machines, tuggers, impact wrenches, chain hoists, etc., and moved in ahead of time to avoid congestion.

At the earliest possible time a special telephone is installed in the structure so that orders can be dispatched from ground level. This system is particularly useful when working on the elevator. The operator on top of the structure can communicate with the workmen at the base of the elevator and control the movements of the elevator for inspection or repairs.

Catalytic cracking section.—All of the foregoing discussion has been of the general nature which could be applied to most T.C.C. unit turnarounds. It should be interesting to discuss some phases of inspection and repairs that have occurred at Lion's T.C.C. unit after 2 years of operation. Since the feed preparation and the product recovery and fractionation sections of the unit are conventional refinery process equipment, the remainder of the discussion will be confined to the catalytic cracking section.

The catalytic section, which is very compact and somewhat simplified as compared with some of the earlier units, is composed of one 10 by 10½ by 95-ft. catalyst-regenerating kiln, a single elevator with tricompartment buckets and a combination reactor, hopper, and hot-catalyst storage bin in one shell. All of this equipment is contained in a steel structure about 185 ft. high. Most of the accessory equipment such as pumps, air preheater, blower, and inert gas generator, is located at ground level and is very accessible to maintenance crews.

Permanent platforms are located at all kiln, reactor, and elevator openings so that the work can be carried on with a minimum of time lost and with very few temporary platforms required. The west side of the unit has plenty of open space on the ground, as well as up the side of the structure, so that all heavy equipment can be hoisted from ground level to any point on the structure without interrupting the work of other crafts. Very few special tools are required for kiln and reactor maintenance because conventional practices are followed.

Reactor.—The reactor tower is lined with 4-in. strips of 410 alloy welded circumferentially. At the end of the first run, several of the alloy strips had bowed along the longitudinal axis and some welds had failed as a result. These damaged strips, of which there were only six, were flattened and welded back in position as shown on the accompanying photograph. Of the 3,800 ft. of welded alloy seams, only 10 ft. required attention at the end of 1 year. At the end of 2 years no further failures had occurred, all repairs were holding, and the erosion rate had dropped to practically nothing.

There was, however, an erosion condition in the catalyst downflow distribution system. These distributors were originally 10-gage, type 410 alloy pipe with 45° bends. It was in these bends and slightly below where erosion occurred. At the end of 2 years the distribution system was replaced with Schedule 80 pipe of 410 stainless steel. On the basis of previous erosion rates, this material should last about 4 years at the same catalyst circulation rate.

Kiln.—The catalyst collector assembly in the bottom of the kiln was originally fabricated of carbon steel. By the end of 1 year's operation, difficulties in catalyst flow were experienced. The carbon-steel gratings, plates, and downpipes were scaling off due to high temperatures and the loose scale was plugging the catalyst downpipes. A replacement assembly with plate and grating of Si-Chromo 5 was chosen because of its heat resistance and strength at temperatures of 1,100° F. The downpipes and tubular structural members were replaced with Type 304 stainless steel. No trouble is anticipated with this section of the kiln in the near future.

The kiln cooling coils have lost no

metal due to erosion by catalyst. Samples removed for inspection have shown original metal thickness. The coils are made up of low chrome seamless steel tubes. No replacements have been made other than the two removed for inspection. The suspended tile lining in the kiln has shown some erosion in 2 years.

The kiln internals are subjected to burning coke at a maximum temperature of 1,100° F. and the weight of the catalyst bed. The air distributor and collector ducts are of 10-gage 4-6 chrome alloy plate. Trouble in the form of separation and warping of these ducts was encountered on the first two runs. A total of 18 ducts had to be realigned or replaced. Following the replacements, $\frac{5}{8}$-in. rods were welded across the tops of the ducts not protected by the kiln cooling coils and no further separations have occurred. Very mild scale has formed on all ducts but none have burned.

Catalyst elevator.—The catalyst elevator, which is housed in a single shell, is a tricompartment bucket type having a circulation rate of 85 tons of spent catalyst and 88 tons of regenerated catalyst per hour. Maintenance on the elevator is facilitated by accessibility of the buckets and links at the base of the shaft. By removing the bottom head, the elevator can be moved slowly so that close inspection can be made of the buckets, bucket brackets, link bushings, pins, and thimbles. When maintenance on the head shaft assembly becomes necessary, the chain is supported by chain hoists from the structure, the links are separated, and the entire head shaft assembly can be removed for replacement or the traction rims may be ground in place.

After 1 year of operation it was established that the first point of wear occurred in the chain bushings and pins. The actual wear in the chain links was figured by dividing the total elongation $3\frac{3}{4}$ in. "cold" by the elevator centers 158 ft., which gave the wear per link 0.0237 in., part of which was in the bushings and part in the pins.

Wear on the chain knuckles averaged 0.011 in. per month during the first year of operation. On the basis of $\frac{3}{8}$-in. maximum wear allowable it was estimated that it would be necessary to remove the chain from service for reconditioning during the turnaround after 2 years of operation.

During the first year of operation, the traction rims began to wear unevenly because of the constant impact of the worn bushings against the periphery of the rims. The thickness of the traction rims varied as much as 0.030 in., making it necessary to grind them down to an even thickness. This measure was necessary to eliminate as much as possible any unequal travel of the chains with resultant breakage of bucket brackets and attendant difficulties. It is possible after using an elevator chain for approximately 2 years to invert the chain and allow the unworn side of the knuckle to ride against the traction rims. In this plant, however, it was decided after 2 years of operation to completely remove the worn chain and buckets to the shop for repairs at a later date, and to install a new chain with new alloy buckets. A complete new head shaft assembly with new traction rims was installed at the same time. These changes placed the elevator in practically new condition without loss of time for repairs.

In the original installation it was necessary, due to scarcity of suitable steel, to substitute a .10-.20 carbon-steel material for the elevator buckets, which did not prove very satisfactory at 1,100° F. operating temperature. There was considerable warping, and cracking of the buckets at the welds and at the brackets where they attached to the chain links. The replacement buckets were fabricated from Cor-Ten, a low-alloy high-tensile-strength steel which should give longer life.

Catalyst lines.—The catalyst piping, for inspection purposes, may be broken down into two parts. First, there are the circulating lines, which are in continuous use and are 6 in. or larger. All of these lines have "chicken ladders" installed to arrest ero-

(Continued on page 346)

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Model 26-102

SPECIFICATIONS

Sensitivity The Titrilog quantitatively records oxidizable sulfur compounds in concentrations as low as one part in ten million or 0.005 grains per 100 cubic feet.

Power Requirements The Titrilog operates on standard 60-cycle 115-volt power. It requires approximately 6 amperes.

Cabinet Dimensions The Model 26-102 Titrilog is housed in a floor-mounted cabinet 66-inches high, 22½-inches wide, and 18½-inches deep. The strip-chart recording milliammeter is mounted at eye level, and directly below it is the control panel.

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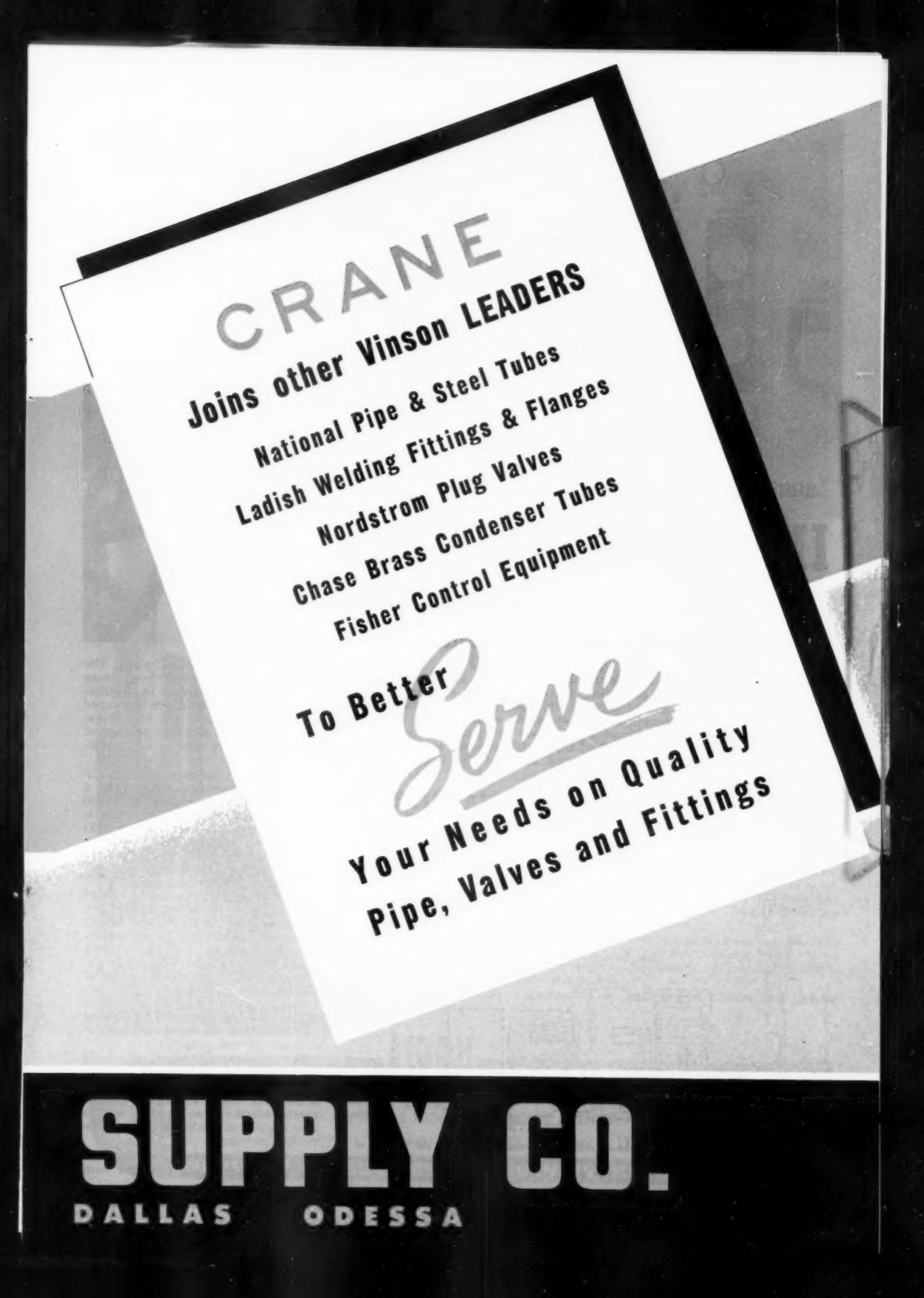
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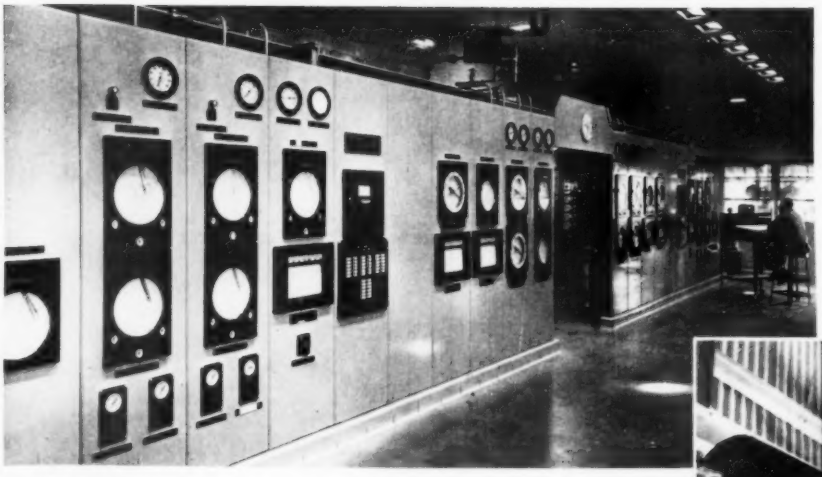


Left: Instrument panel in the control room at the vacuum units of the Cit-Con Oil Corp. plant.

Below: Temperature controller on primary chiller in No. 1 M.E.K. unit. Controls charge mix temperature to filter feed tank. Valve located on propane vapor line.

Latest Improvements in

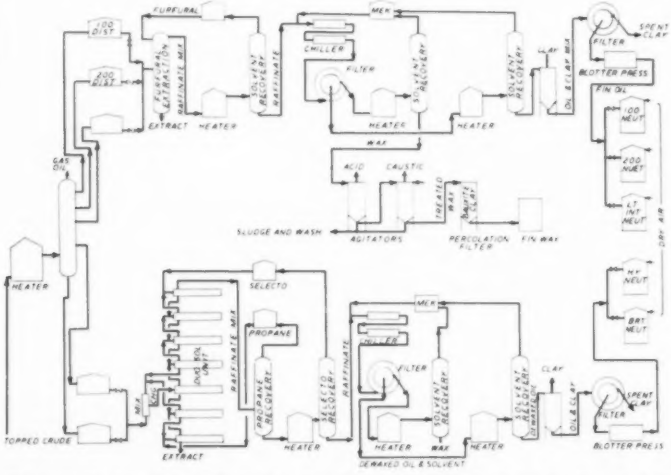
INSTRUMENTATION

Installed at Cit-Con Plant

by Cit-Con Engineering Staff

THE all-lube plant of Cit-Con Corp. at Lake Charles, La., was placed in operation during the last half of 1949. Design output of the refinery is 6,000 bbl. daily, consisting of five grades of lube stocks ranging from 100-viscosity neutral to 150 - 160 - viscosity bright stock. In addition to lubricating oil, the plant also produces several grades of paraffin and microcrystalline waxes.

Blends of crude oils, selected for top-quality lube-oil stocks, are gathered at the Cities Service refinery, adjacent to the Cit-Con plant. The light oils are removed from these blends at Cities Service by distillation, and the long residuum is pumped to the Cit-Con plant for feed stock. Only the lube-oil and wax portions of the crude oil are refined in the Cit-Con operations.



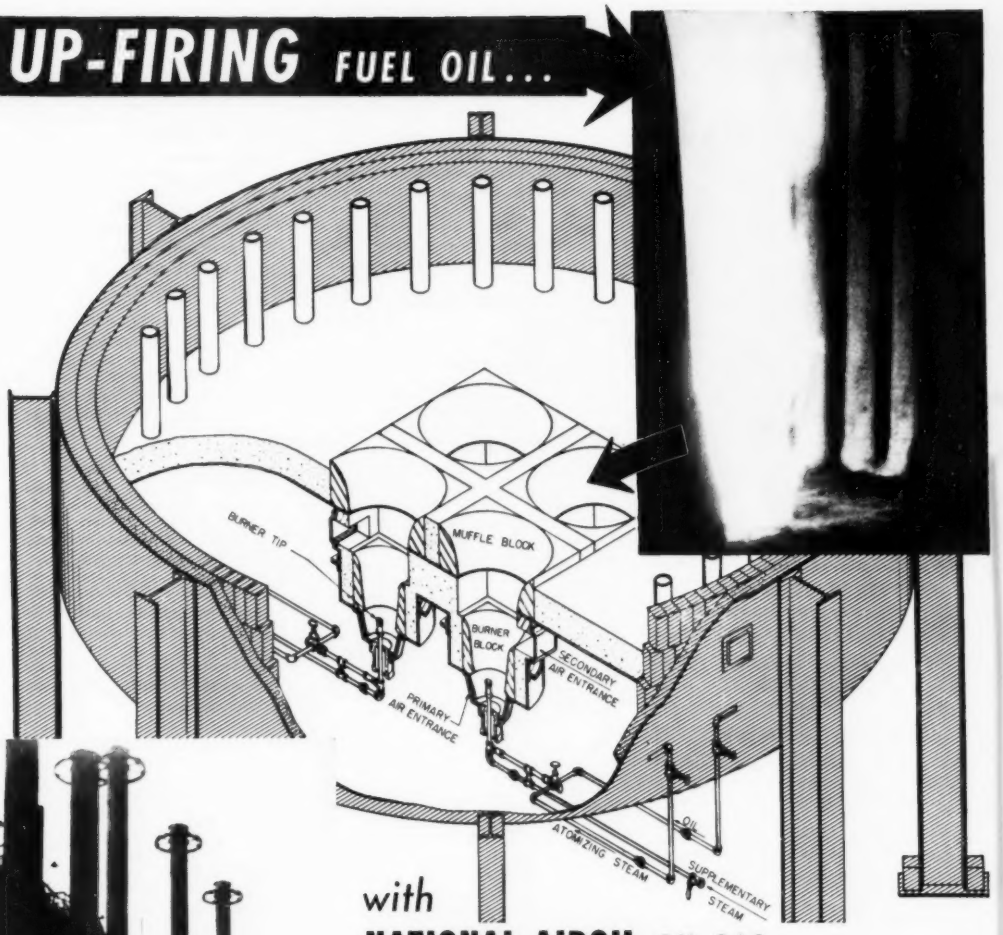
Diagrammatic layout of Cit-Con's lube-oil refining process. This plant, the largest of its kind, processes 6,000 bbl. per day of topped crude oil to various grades of lube oils and waxes.

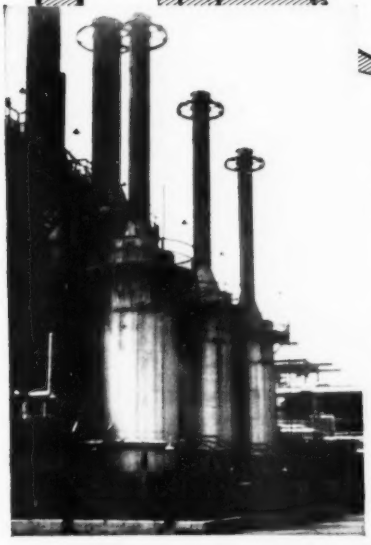
The lube-oil refinery is made up of (1) twin vacuum units, having a combined charge capacity of 25,000 bbl. a day, where the feed stock is divided into five lube-oil cuts, (2) solvent - extraction units, which include a Duo-Sol unit, where the two heavier lube cuts are extracted, and a Furfural unit for the three lighter grades of lube oil, having a design capacity for circulating 30,000 bbl. of solvent per day, (3) two M.E.K. dewaxing units, one for processing the lighter grades of oil and deoiling crystalline waxes, and the other for processing the two heavier grades of oil, (4) twin clay contact units with a total capacity for finishing 6,000 bbl. of oil daily, and (5) wax-treating and filtering plant for the production of fully refined waxes.

In the design of the processing units latest improvements in instrument design and application have been utilized to make the operations as nearly automatic as possible and to insure uniform quality control of the various streams.

In general, recording controllers on the panel boards are provided with

UP-FIRING FUEL OIL...





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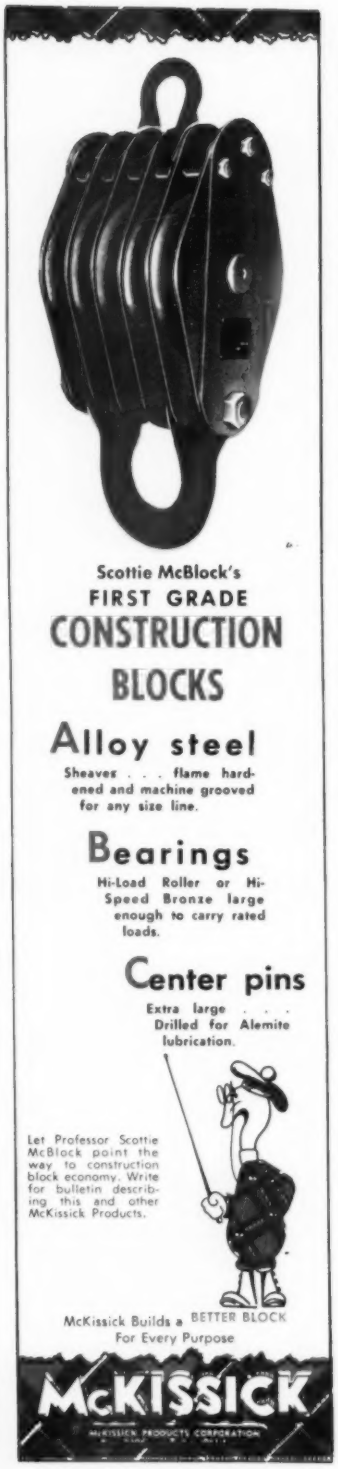
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integral bypass panels which are particularly useful for remote manual control when making routine zero checks on flow transmitters. To facilitate the recording of operating data and subsequent ease of unit control, a movable desk mounted on casters has been provided for each control room. This permits the operator to move the desk along the front of the instrument board as he records operating data. A well-equipped instrument shop has been provided for proper maintenance and service of all units.

Compressed air for instrument and general plant usage is produced by three compressors, two electrically driven and one steam driven. Compressed air goes through water coolers to a receiving drum. The air leaving the drum supplies both the instrument air system and plant air. Automatic loading and unloading valves maintain a pressure of 115 psig. on the instrument air supply. In case of low air pressure, the plant air is automatically shut off and all available air goes to instrumentation.

Should the plant electrical-power supply fail, standby steam-driven generators supply power to maintain essential instrumentation and lighting for safely closing down all operating units. Instrument air is dried to a low dew point by an automatically reactivated air drying system. Pressure regulators at each operating unit reduce the instrument air to a working pressure of 50 psi. The pressure is further reduced to 18 to 20 psi. into a brass air header supplying all the panel-board instruments on each unit. Since the Cit-Con plant handles only the waxy portions of crude oil, special planning for instrumentation has been necessary in that many of the instruments must be designed with steam tracing, sealing, or purging of pressure gage and flowmeter lines. Continuous purging is necessary in many cases.

The quantity of reduced crude charged to the vacuum unit furnaces is controlled by flow-recorder controllers. Temperature-recording controllers maintain the desired temperature of the oil leaving the furnaces by controlling the fuel-gas supply to the furnaces. Recording absolute pressure controllers maintain a pressure of approximately 50 mm. Hg. absolute in the vacuum flash tower. The pressure tap lines have manually regulated "Rota-meter" air purge. Five side streams are taken off the vacuum tower with gas oil from the top side stream refluxed to control top tower temperature.

The volume of reflux is automatically controlled by a flow controller with index set to maintain desired temperature in the top section of the tower. The other four side streams are lube distillates and go from the tower into steam strippers which control the flash point of the oils. The volume of flow of each side stream is controlled by predetermined liquid levels in the strippers, with valve setting on the tower drawoff lines being automatically controlled by the levels in the strippers. Flow of the residuum coming off the bottom of the towers is controlled automatically by a level-recorder controller. This residuum is eventually finished as 150 viscosity bright stock.

The residuum and lower side stream from the vacuum units are solvent extracted by the Duo-Sol process in a unit designed for an approximate charge rate of 10,000 bbl. of oil per day. The flow of oil to the Duo-Sol plant is automatically controlled by a flow-recorder controller, as is the Selecto and propane. The solvent ratios are thus predetermined and automatically controlled throughout any period of operation. Seven extraction drums in series are used in the extraction process, with the charge oil going into No. 3 drum, propane into No. 1 drum, and Selecto into No. 7. The propane and Selecto flow countercurrently through the series of drums, with the propane dissolving and carrying the raffinate (good oil) from the top of No. 7 drum, and the Selecto taking the extract out the bottom of No. 1. The two solvents are not completely miscible and each extraction drum contains two layers of liquid which are visible through gage glasses.

The raffinate in propane solution, coming from No. 7 drum, flows to a flash tower where the propane is removed. This raffinate flow is controlled by a flow-recorder controller. After flashing the propane off, the stream is heated and steam stripped to remove the last traces of Selecto and propane. The fuel supply to the raffinate heater is controlled by the temperature-recorder controller on the oil from the furnace. The liquid levels in all towers are controlled by automatic level controllers.

Extract and Selecto mix coming off the bottom of No. 1 drum is split, with part of it going directly to a tower and the other through a heat exchange to the first tower for primary removal of propane. The fuel to each extract heater is controlled by the temperature-recording controller on the stream leaving the furnace. The extract stream then goes through four flash or stripper towers, by which all Selecto and propane are removed. The liquid level in each tower is predetermined at a safe point, then streams from the towers are controlled by automatic valve settings from the liquid-level controllers.

The three lighter side streams from the vacuum unit are solvent extracted by the furfural process. The oil to the unit is controlled by a flow-recorder controller, and the solvent feed is also controlled automatically. A level-recorder controller controls the level of the extract interphase inside the extraction tower by the flow of extract mix from the tower,

and the flow of raffinate mix from the tower is controlled by the liquid level in the top of the extraction tower. The temperature gradient in the extraction tower is controlled by two intercooler streams which circulate from the tower and back through coolers.

Cooling of the streams is automatically controlled by means of a three-way temperature control valve, regulating the portion of the stream going through or bypassing coolers. Raffinate mix flows from the extraction tower to an accumulator, from which it goes through a heater to a vacuum flash tower for removal of solvent. Flow to the furnace is controlled by a flow-recorder controller and the fuel to the furnace is controlled by a temperature-recording controller on the stream from the furnace.

Vacuum in the flash and stripping towers is maintained by a vacuum pump taking suction through a liquid trap. A level controller in the stripper bottom controls the raffinate product flow. The extract mix from the bottom of the extraction tower flows to an accumulator, from which it is pumped to a recovery system for removal of furfural, which is similar to that of the raffinate, except that a larger volume of solvent must be removed and two additional stages of flashing are required. Back wash from the extract pressure flash tower to the extraction, whenever operations require, is controlled by a flow-recorder controller.

The two methyl-ethyl-ketone dewaxing units are similar in their operation, except that No. 1 unit dewaxes the three lighter grades of oil and deoils the crystalline waxes, whereas No. 2 unit dewaxes the bright stock and heavy intermediate stock, with repulping of wax for oil recovery. Dewaxing procedure is the same on both units, except that different proportion of M.E.K., benzol, and toluol are used. The ratio of solvent to waxy oil charge to these units is controlled by a flow-recoder ratio controller.

After the solvent and oil charge streams converge, the mix is split into two or three streams, depending on operation, for charging to double pipe exchangers and propane chillers where the total flow is controlled by a flow recorder controller on each stream with the total flow through the exchangers being recorded on the flow-recorder ratio controller. The desired temperature of oil-and-solvent mix from the chillers is controlled by a temperature-recorder controller which controls the propane vapor flow from the chillers.

From the chillers the oil-and-solvent mix goes to a filter feed tank then to rotary filters in which the liquid level is controlled by level controllers. Cold wash for spraying on the wax-coated filters is chilled by propane chillers in the same manner

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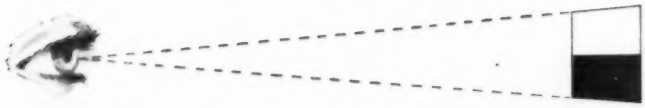

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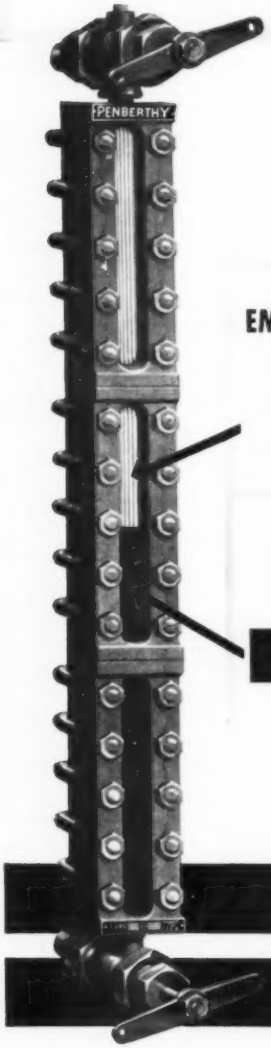

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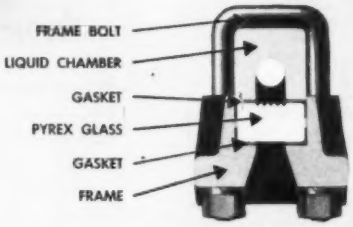

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as the waxy oil and solvent mix, except that control is on liquid propane to the chillers, and fed to the filters at approximately the same temperature. Pressed oil from the filters flows to a filtrate receiver where the liquid level is controlled by a level controller, setting the index on the flow controller from the receiver.

Filtrate mix goes through the double pipe exchangers to cool the waxy oil and solvent charge, then to the solvent-recovery-system surge tank. From the surge tank the filtrate mix is pumped to a low-pressure flash tower, in which a liquid-level recorder sets the index on the flow-recorder controller on the filtrate mix stream to the tower. The filtrate mix from the bottom of the low-pressure flash tower flows through a furnace, then to a high-pressure flash tower. The desired temperature of the stream from the furnace automatically controls the fuel-gas flow to the furnace by a temperature-recording controller. The pressure of the high-pressure flash tower is controlled by a pressure-recorder controller which controls the flow of condensed vapors leaving the tower. A liquid-level controller on the tower automatically sets oil flow from the bottom of the tower. The oil then goes through a stripper and to raw-oil storage with a liquid-level controller in the stripper governing the flow of oil from the unit.

In No. 1 M.E.K. unit the wax is recrystallized in order to control oil content of the fully refined wax production. The primary wax is diluted with solvent, warmed in the double pipe chillers by heat exchange with incoming waxy oil charge. It is then chilled by propane expansion to the desired filter charge temperature. The wax mix is then filtered, cold washed and dried of solvent. The instrumentation on this process is similar to that of the primary filtration.

The entire dewaxing system is blanketed with inert gas. This gas is maintained at sub-atmospheric pressure for loosening the wax cake ahead of the filter scrapers. Rotary-type filters have 625 sq. ft. of surface area each. There is a total of 16 filters in both dewaxing units. In the No. 2 M.E.K. unit the microwax or petrolatum is repulped for oil yield.

Propane is used as the refrigerant at the M.E.K. dewaxing units. Three four-stage centrifugal compressors, each driven by a 3,840-hp. steam turbine, supply circulation for the refrigerant through the chilling system. All of the steam turbines operate on 600-psi. steam with two of them exhausting into the 200-psi. steam supply system and the other one exhausting to condensate under vacuum. For normal operation the condensing turbine and one of the 200-psi. exhaust turbines will be used with the other 200-psi. exhaust turbine as a standby in order to balance the plant steam requirements. The turbines are designed to operate at 5,250 r.p.m., with direct drive to the compressors, and utilize approximately 150,000 lb. per hour of 600-psi. steam on the 200-psi. exhaust, and 33,000 lb. per hour on the condensing turbine.

Propane discharges from the compressor at 200° F. and is cooled through water coolers to approximately 107° F., then goes to storage at a maximum pressure of 180 psig. Liquid propane from storage goes through two economizers before reaching the oil and solvent chillers. The first economizer chills the propane to approximately 69° F. and the second reduces the temperature to approximately 29° F. The propane stream to the economizer is split and an automatic valve controls the flow of propane into the shell by a level controller on the liquid inside the economizer. The vapor line from the first economizer goes directly to the high-pressure stage of the compressors and from the second economizer to the second stage of the compressor.

The chilled propane at 29° F. goes to the double pipe chillers for chilling the waxy oil and solvent charge to the M.E.K. dewaxing units. Each group of chillers consists of 12 double pipes with a central propane feed drum, and are tilted slightly to facilitate separation of propane gas. Propane from the second economizer at 29° F. goes to the feed drum above each group of chillers, where a liquid-level controller governs the flow of propane to the drum.

Liquid propane flows down to the lower end of the outside shell of the double pipe chillers and propane vapors come off the upper end and then back to the vapor section of the drum from which the compressors take suction through a compressor suction trap. The suction trap prevents any liquid propane from reaching the compressor suction line. A propane vapor line from the vapor section of the storage drum or accumulator to the suction trap supplies the compressor in the event that the flow through the compressor drops below a desirable minimum. Under normal operation the pressure on the suction trap is controlled by a pressure-controller recorder, controlling the makeup or recycle of propane vapors from the accumulator. In the event of excessive high pressure in the suction trap, a relay works in conjunction with the pressure controller and snaps the propane makeup valve closed. If the flow from the discharge of the propane compressor drops below a desired minimum the flow controller takes over the control of the pressure control valve, permitting a greater volume of propane vapors to circulate through the compressor. The suction trap can be kept free of liquid propane by a pump which takes suction from the bottom of the trap.

Automatic controls stop any compressor in case of low oil supply or pressure, high oil temperature, high propane level in any of the vessels feeding the suction, or high discharge pressure or temperature.

After dewaxing, the lube-oil stocks are all finished by clay contacting. On these units the oil charge is mixed with the desired amount of contact clay, heated, stripped with steam, then put through rotary filters and blotter presses to remove the clay. From this operation the lube oils are ready for shipment. Clay to the mix tanks is added by "Syntron" feeders on which the balance is set to carry a constant weight of clay on a short conveyor belt. The vibrators feed clay to the conveyor at a rate set by the balance index. Other controls on stream flow, temperatures, and pressure on the clay contact units are similar to those already described on other units.

The main-plant steam-generating system consists of three 650-psi. boilers, with a capacity of 125,000 lb. per hour each. The water-treating chemicals are proportioned by a proportioning meter takeoff from the raw-water flow-recorder controller. After softening, the boiler feed water goes to a deaerator. A flow instrument in connection with a pH recorder controller feeds sulfuric acid to a constant pH value on the feed water. Feed water to the boiler is controlled by liquid-level controller on water in the boiler drums.

A pressure controller takes impulse from the main steam header and positions the induced-draft fans on the operating boilers. This changes the differential pressure drop through the fire box which controls the setting on the fuel gas valve.

Four separate steam systems are maintained in the plant. The 600-psi. steam operates the refrigeration compressors and three of the plant circulating cooling-water pumps. Two of the compressor turbines exhaust 200-psi. steam which operates other turbine and steam pumps throughout the plant. If more 200-psi. steam is needed, a steam-pressure reducing system of newly designed heavy-duty diaphragm motor valves reduces steam from the 600-psi. system to the 200-psi. system directly. As steam is reduced from 600 to 200-psi. pressure, its temperature is automatically controlled by mixing with condensate. Other steam-driven centrifugal pumps operate on 200-psi. steam and discharge into a 15-psi. clean steam system. There is also a reducing system to take steam from the 200-psi. to 15-psi. system as desired. Exhaust steam from reciprocating pumps is discharged to a 12-psi. oily steam system, which is used for heating coils in tanks, etc. This system is maintained at 12 psi. and the clean exhaust steam at 15-psi. pressure so that any leak between the two systems would not get oil into the clean system.

Continuous Analysis and Control Of Process Stream Compositions *With* Automatic Infrared Analyzers

by T. C. Wherry and F. W. Crawford

MODERN trends in processing petroleum hydrocarbons have created a demand for closer control of operations to meet desired standards of product quality. There is a particular need for reliable plant instruments capable of making continuous quantitative measurements of one or more of the components in complex hydrocarbon streams. If the full advantages of such instrumentation are to be realized, it is obvious that the instrument must be located near other plant process controls for immediate and convenient availability to the operators and for connection to direct automatic control when desired.

Instrument-design requirements which must be met include safety, extreme reliability, proper sensitivity and selectivity, good appearance, and accessibility for maintenance. It is also absolutely essential that the sensing device be specially adapted to the particular analytical problem at hand.

There have been several papers published dealing with automatic infrared analyzers. Williams[1] gives an excellent review of infrared techniques and pertinent literature. Deinum and Reitveld[2] have reported tests of a commercially available analyzer. The purpose of this paper is to describe several plant installations of automatic infrared analyzers which have given dependable automatic analysis and automatic control.*

The installation shown in Fig. 1 is located in a plant control room near a furfural extractive distillation column separating n-butane from 2-butenes. A sample of vapor from the thirtieth tray of this column is con-

*Patent applications have been filed covering this equipment.

The Authors

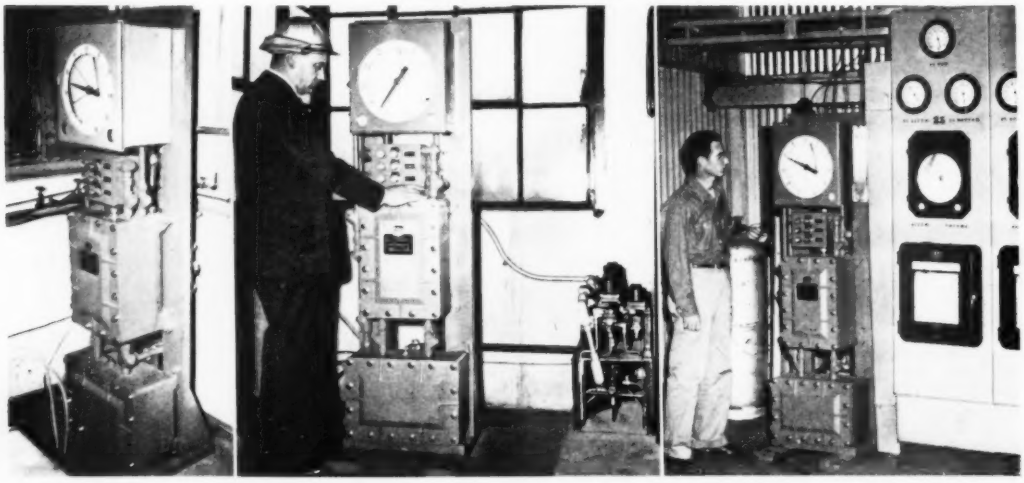
T. C. WHERRY

F. W. CRAWFORD

T. C. Wherry is supervisor of the special instrument section, instrument and equipment division, of the chemical engineering department, Phillips Petroleum Co. He received B.S. degrees in both electrical engineering and chemical engineering from Kansas State College in 1938. After joining Phillips in 1938, and previous to his present assignment, Wherry worked in the production and research departments on the development of new geophysical instruments.

F. W. Crawford is supervisor of the chemical physics section in the physics division of the research department, Phillips Petroleum Co. He received his B. A. degree from Phillips University, Enid, Okla., in 1928 and his M.S. and Ph.D. degrees in physics and mathematics from University of Oklahoma in 1934. He was a teaching assistant at the University of Oklahoma 1929-31 and a full-time instructor in physics at the same University 1931-37. He joined Phillips as a member of the research department in 1937.

Fig. 1—(Left) This instrument continuously measures and records the total unsaturates in the vapor on the thirtieth tray of 100-tray furfural extractive distillation column and controls the flow of lean furfural to hold the concentration between 30 and 35 per cent unsaturates. Fig. 2—(Center) Automatic infrared equipment which monitors the concentration of isobutane in two different three-component streams on an alternate time cycle. The full scale sensitivity is zero to 100 per cent isobutane. Fig. 3—(Right) In this installation the concentration of isobutane at the sixteenth tray of a deisobutanizing column is measured and recorded continuously. High purity of the normal butane bottom product is maintained by direct automatic control of steam to the reboiler. The full scale range is zero to 30 per cent isobutane.



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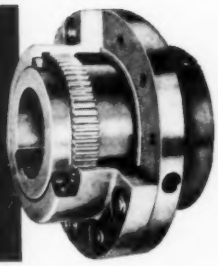

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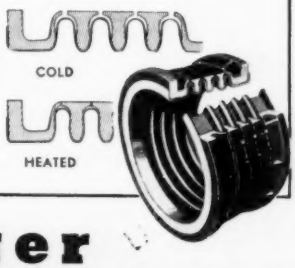

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tinuously analyzed for total unsaturates. Under normal operating conditions, if the unsaturate concentration on this tray is held between 30 to 35 per cent, the n-butane and 2-butene end products will be of the desired purity. The recorder shows the concentration of unsaturates in this stream with full-scale coverage from zero to 70 per cent. The accuracy is better than ±2 per cent unsaturates. Partial automatic control of the column is effected by using the pneumatic control mechanism in recorder to reset rate of flow controller on lean furfural solvent stream.

In connection with these automatic analyzers it is always necessary to incorporate some means of obtaining a clean representative sample which in this case involves a system for removing entrained furfural and water. The complete installation including sample handling equipment has been in use for more than 6 months. It has proved to be reliable, accurate, and relatively trouble free during this period. In regard to safety, the construction is such as to meet the requirements of the National Electrical Code for Class I, Group D, Division 2, locations.

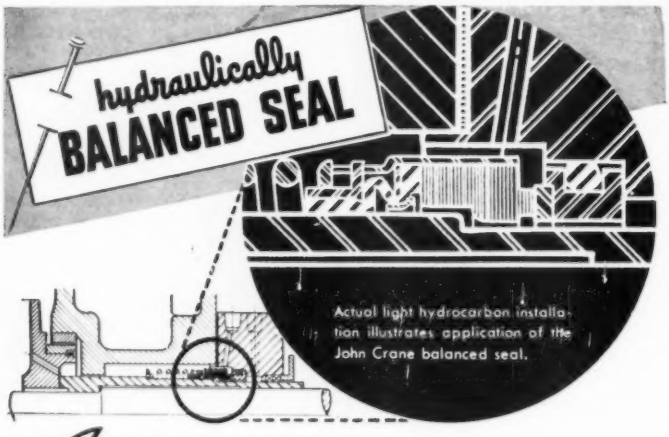
The units shown in Figs. 2 and 3 are similar in construction to the first mentioned instrument but are somewhat different functionally. One continuously determines the per cent isobutane over a range of zero to 100 per cent in two separate HF alkylation unit streams on a time sharing cycle. The other analyzes the vapor from the sixteenth tray of a normal butane-isobutane fractionating column with a full scale sensitivity of zero to 30 per cent isobutane. The latter instrument has been successfully used to control automatically and directly the operation of the column by controlling amount of steam charged to column reboiler. Accuracy of both instruments is approximately ±2 per cent.

Fig. 4—The methane content of 18 different streams in a process are analyzed and recorded in sequence with this instrument. Full scale covers zero to 5 per cent methane. The scale is expanded at lower concentrations being approximately logarithmic in character.

An instrument different both in construction and function is shown in Fig. 4. By means of a specially designed valve and switching arrangement 18 plant streams are sequentially analyzed for methane in the range of zero to 5 per cent with an accuracy of about ±0.2 per cent methane at full scale. The absolute accuracy is better at lower concentrations. The total cycle requires 2 hours. A device is provided which indicates to the operator which stream is being analyzed and the strip chart is coded to permit identification of streams on the record.

In application, it has been found practicable and economical to employ such instrumentation in a variety of services. Even in instances where there is marked interference between the component to be measured and other constituents it is usually possible to produce a significant record. At present, applications are largely confined to hydrocarbon streams which are in the gaseous state at atmospheric conditions.

1. Van Zant Williams, Rev. Sci. Inst. 19, 135 (1948).
2. H. W. Deinum and B. J. Reitveld, Recueil 67, 725 (1948).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Above: The El Dorado, Ark., refinery of Pan-Am Southern Corp. Left: Rating on this fluid cat unit is 8,000 bbl. daily at 50 per cent conversion.

MAINTENANCE of a Fluid Cat Cracking Unit

. . . in a medium-size refinery, and particularly during the turnaround period

by T. J. Byrne* and F. M. Jenkins*

THE maintenance of catalytic cracking units, especially during the turnaround period, is a major problem in refineries with limited manpower. Pan-Am Southern's refinery at El Dorado, Ark., is typical of the many medium-size refineries which must cope with this situation. This refinery has a crude capacity of 25,000 bbl. daily and includes catalytic cracking, thermal cracking, polymerization, and alkylation facilities, together with the usual associated finishing, blending, and shipping facilities. Currently about 300 people are employed in the refinery; approximately 200 are process and maintenance employes on the hourly pay roll.

The catalytic cracking unit, which was built during the war as a part of the 100-octane aviation-gasoline facilities at El Dorado, has a current gas-oil charge capacity of approximately 8,000 bbl. per day and is operating at about 50 per cent conversion. This unit has been increased from the design rate of 4,500 bbl. per day to its present capacity through many revisions over the past 3 years. These revisions, covering such changes as installation of additional heat-exchange equipment, modification of the major vessels, removal of many line limitations and such, have been done, in the main, by the refinery forces without appreciably increasing down time. The major portion of these changes were made after 1946 and, as indicated in the following tabulation a very satisfactory operating service factor (days on stream/total calendar days) has been obtained, due largely to the efficient planning and execution of the revisions and maintenance.

Run started	Days on stream	Days down	Service factor
January 1947	256	13.1	95.5
November 1947	144	17.2	89.3
April 1948	17	3.4	83.0
May 1948	75	7.3	91.1
August 1948	224	9.1	96.1
March 1949	222	10.1	95.6

The problem of proper unit maintenance resolves itself into two phases. These are (1) the routine services and repairs performed during normal operation, and (2) the rather complicated inspection and repair items effected during the turnaround. The first phase, servicing the plant while on stream, involves routine checking, lubricating and repairing equipment during operation. This maintenance is much the same on the catalytic cracking unit as any other refinery operating equipment. Emergency repairs are made as well as conditions will permit to maintain the unit in operation and avoid shutdowns as long as possible.

The maintenance encountered during normal operations of the catalytic

*Pan-Am Southern Corp.

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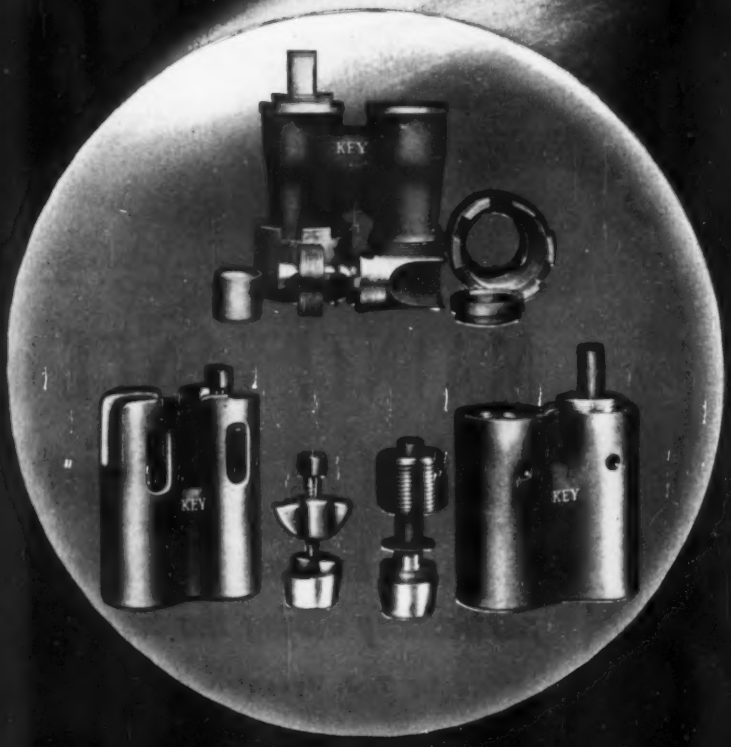

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cracking unit involves on the average approximately three men's time. Occasionally jobs are encountered which might involve as many as six men for short periods. The cost for routine maintenance is rather uniform over the year and the following costs are typical. These costs do not include the vapor-recovery unit.

Routine Maintenance

Man-hours per month, 1,000; materials, dollars per month, $800; total dollars per month, $2,300; total dollars per 1,000 bbl. charge, $11.

Principal items of routine maintenance encountered during the operation of the cat cracker are instrument maintenance, pump repair, valve maintenance, electrical maintenance, exchanger cleaning, and repairs to the catalyst-unloading system. The problems of instrument maintenance are usually confined to purging of instrument lead lines, balancing and adjusting transmitters and recorders, and such seasonal items as installing antifreeze in instrument seals and the thawing of frozen instrument leads.

Routine pump maintenance consists of servicing packing, governor adjustments, and repair of catalyst pump shaft seals. Valve maintenance includes servicing of packing, periodic lubrication of plug valves, and replacements where required and possible. Electrical maintenance is minor and primarily limited to the Cottrell precipitator, elevator, and alarm systems.

Feed preheat shell-and-tube exchangers are cleaned, as warranted by pressure drop or heat transfer, by circulating a cleaning solution (usually Oakite in kerosine) through the fouled side while the exchanger is bypassed. The maintenance of the catalyst unloading system requires frequent inspection of the filter bags in the exhauster system and necessary replacement. Other maintenance items occasionally encountered during operations include replacement of water sprays below the flue gas steam generator, repair of line failures, opening of plugged lines, patching of hot spots, and repair of compressors.

A rather unusual procedure has been developed for repairing catalyst leaks in hot carrier lines that can be accomplished during normal operations. Asbestos rope is employed to plug the hole through which the catalyst is leaking, and a patch plate welded to the line. Following this very temporary repair, successive layers of "hex steel" mesh and "plastic KN chrome ore" are built up over an area somewhat larger than the patch plate, and a large patch plate installed to cover the entire patched area. The builtup repair is preferred over the single patch plate, as erosion of the patch plate in the area of the original hole is a possibility. Repairs of this nature have held up for several months.

The second and principal phase of maintenance, service, and repair to the plant during the turnaround, presents a complicated problem requiring complete coordination between all refinery departments and personnel to minimize both down time and man-hours.

A typical turnaround on the unit utilizes the services of 150 men for a period of approximately 9 to 10 days, totaling about 8,300 man-hours of work. This total man-hour requirement for a refinery of this size means that essentially all of refinery maintenance personnel are needed at the catalytic cracking unit during this period. It is also necessary to employ outside temporary labor to accomplish this job. Arrangements are made with local people and usually the same persons are available if given proper advance notice. During the shutdown period all of the other refinery maintenance work, unless it is of an absolute emergency nature, is postponed until after the catalytic cracking unit is back in operation.

The costs of the turnarounds vary from shutdown to shutdown since there are some items of costly nature which vary in frequency of repetition. The past year's record shown in Table 1 is typical.

TABLE 1—COST OF TURNAROUNDS

General data:	
Period covered:	1-1-40 to 12-31-49
Days' operation	345.8
Days' down time	19.2
Number of turnarounds	2
Service factor, per cent	94.0
Average fresh charge, B.S.D.	7,250
Average gasoline produ., B.S.D.	2,700

Total for both turnarounds:

	Man hours	$	$/Daily bbl. Chg.	$ Daily bbl. Gaso.
Repair labor	16,800	25,200	3.48	9.33
Repair material		20,100	2.78	7.43
Total	16,800	45,300	6.26	16.76

The two turnarounds mentioned in the tabulation were much alike in the amount of work undertaken and an average turnaround cost figure can be obtained by dividing the figures in the table by two. Some plant-modification work was undertaken during both turnarounds and it would be possible to reduce the cost if only necessary repairs are scheduled.

During the past several years the cost of maintenance labor has increased; however, the man-hours required has decreased, indicating the rise of costs has not paralleled the wage increase. Material costs are higher; however, this increase only reflects the rise in the cost of material. Along with the general increase in costs has been an increase in charge rate, with the net result being a decrease in maintenance costs per barrel of gas oil charge.

To complete a turnaround with the total costs indicated, extensive foresight and preparations are required well in advance of the shutdown date. A master plan of action must be evolved. This plan is the result of joint conferences where management, operating, engineering, maintenance, purchasing, and safety departments are represented. Work lists are presented by the various departments covering not only repairs but actual plant modifications. The shutdown report of the last turnaround, which includes the results of the joint inspection by engineering and safety departments, is reviewed and additional items of repair anticipated. Important points to be inspected are noted and tentative plans made for repair of damage due to erosion and corrosion.

All items of work are discussed individually and those determined practical to accomplish and sufficiently justified are incorporated into the master list. Material requirements are developed as jobs are discussed and noted for procurement by purchasing department representatives. Engineering-department representatives note items requiring technical assistance and anticipate this work by investigating such items and preparing sketches where needed. The engineering department may also assist by locating vendors, placing orders, and expediting delivery of special items. The maintenance department representative estimates the time required to perform the various jobs in order to determine the over-all effect of each item on shutdown time.

At a second conference held by the maintenance department superintendent with the craft foremen and representatives of the operating and safety departments, each foreman is thoroughly informed on the items of work to be assigned to his craft and the actual technique of performing questionable jobs is discussed. The safety department reviews the details of the proposed method of repair to make certain that no undue hazards will arise. Jobs are also studied for assignment of priority and to segregate those which can be performed during the shutting-down or starting-up periods. Special emphasis is placed on planning jobs to prevent interference. For instance, insulators are not required to work below welders, and blinds are used to prevent spread of welding fumes to other equipment where they might hinder repair. A sequence is developed based on priorities to coordinate the work for smooth execution.

The manpower requirements for the work to be accomplished are reviewed and shifts scheduled. All work is on a 24-hour basis and accomplished by either three 8-hour or two 12-hour shifts, depending on the availability of skilled or unskilled

manpower. The 12-hour shifts are scheduled with the attendant overtime, as this procedure is more economical than maintaining an oversupply of skilled help for normal refinery maintenance. Deficiencies of manpower are reported to the personnel department.

As the date of the turnaround approaches, maintenance-department advance preparations get under way. Typical advance preparations by the maintenance department include such an item as preparation of spare slide valve throats and disks, by coating with "Resist-O-Loy" and grinding for valve clearances. Steel plate is rolled to the diameter of lines suspected as a result of the preliminary shutdown conferences to require patching or replacement. A supply of pipe bends is fabricated in various standard radii for similar repair.

Plant modification work is expedited by completing insofar as possible all that can be done before the shutdown including the fabrication of lines up to the point where they actually tie into operating equipment or "live" lines. Equipment required for repairing and servicing the plant, both tools and material, are transferred to the jobsite as near the point of use as practical. Welding machines are moved up into the structure to the level of the top elevator stop to facilitate the welding at the upper levels. Also, scaffolding is erected where required for repairs or inspection.

On extremely rare occasions, advance preparations also include obtaining the services of a contractor where the nature of a particular job is such that it cannot be handled effectively by the regular refinery maintenance crew. When a complete new regenerator multiclone was installed during the shutdown of April 1948, a contractor was selected who had just completed two similar jobs.

The changeover to new regenerator multiclones was completed with a down time of only 17.2 days. In the course of this installation it was necessary to cut the top out of the regenerator to remove the old multiclone and provide access for the new. A steel hoisting structure was erected, prior to shutdown, at the top of the regenerator to facilitate handling of the units and the top section of shell. Parts of the new multiclone were fitted on the ground before shutdown to decrease assembly time during the turnaround.

Installation of three grid-type restriction orifices in the regenerator flue gas line was simultaneously accomplished by the same contractor. This job was expedited by replacing two sections of the 48-in. diameter flue gas line with new sections containing the grids. These sections were assembled prior to the shutdown with orifices, retainers, liners, and castable insulation in place.

For a normal turnaround, shutdown of the plant begins on the scheduled date. The shutdown follows a slow and orderly procedure beginning with reduction of the feed rate. When all of the feed is out of the reactor, a little oil is charged through the fractionation system to wash it clear of cracked products. Hydrocarbon liquids are drained from the unit and the equipment then steamed to make it safe for entering. Simultaneously, removal of catalyst from the reactor and regenerator is started, 24 to 36 hours normally being required to transfer the 125 tons of catalyst through coolers to storage hoppers.

While catalyst is being removed the maintenance and repair work of the turnaround gets under way with the opening of towers and drums, dismantling and cleaning of heat exchangers, and the overhauling of pumps, turbines, and instruments. Air movers are installed in manways of the hot vessels as soon as possible, to lower temperatures and permit early entry of inspection and repair crews.

As early in the shutdown as possible, lines connecting the unit to operating sections of the plant are blinded and equipment isolated for safe repair. Portable swinging scaffolds, which are bolted together for fast assembly inside lines, are used for repair to vertical sections of lines thereby saving time required for con-

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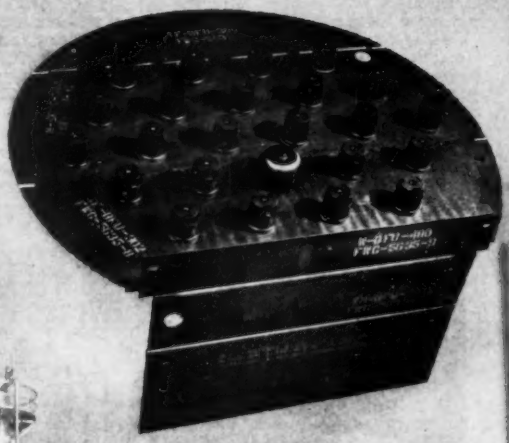

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struction of temporary scaffolds. In special instances hinged ladders, which can be dismantled in sections, are used in the bends of the large catalyst lines.

Repairs required to correct damage not anticipated and found by inspection are incorporated into the master work list. The engineering department observes results of the inspection and supplies technical assistance, where needed, to obtain the most effective repair. Largely through past inspection, zones of serious erosion have been located and protected by alloy lining, steel padding, or castable insulation. As a result present runs are considerably longer than those realized in earlier operations and service factors correspondingly better.

Supervisors responsible for making spot decisions are available 24 hours a day to prevent unforeseen complications holding up the turnaround. This feature is essential to an efficient shutdown, as with the close scheduling and planning of work items, a delay of a single craft on one small item may result in a considerable delay in the over-all turnaround time. When problems of this nature arise, the supervisors on hand, in cooperation with the operating, maintenance, and technical personnel, take steps to alleviate the problem and keep the job moving. Where extensive consideration is required, such problems may be handled in the regular daily operating conferences of management, operating, maintenance, and engineering - department heads.

As quickly as possible after the cleaning, inspection, and repair have been completed, the equipment is reassembled and reinstalled. In this manner a check of "bottle neck" jobs is simplified, and confusion resulting from quantities of material congesting the working areas is minimized. A cleanup crew works throughout the shutdown removing and clearing oil, catalyst, and waste spills. By keeping the unit area clean throughout the shutdown, a safer and more efficient turnaround is accomplished.

Jobs are checked off the master work list as they are completed by the craft foreman. The chief operator and process engineer each have copies of the master list which they check daily to provide independent completion data. At the end of the turnaround, the maintenance superintendent, chief operator, and process engineer each review their respective lists and compare the completed items to pick up any unfinished work.

As the shutdown draws to a close, equipment is flanged up, blinds removed and the warmup process begins. During this warmup, which is accomplished with hot air and steam followed by oil circulation, numerous small jobs of deferred work are completed. These deferred jobs are those that can be done with the plant in partial operation and are scheduled last in the time table to shorten the actual down time. They include painting, insulating, and instrument work.

Catalyst is brought back into the system to normal operating levels and the reactor cleared of air with steam. Oil is introduced into the fractionation system and this equipment warmed up. Then oil is started into the reactor and the plant is again on stream. Thus by carefully developing and following a shutdown work schedule, the turnaround is accomplished smoothly in a minimum time with minimum effort.

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BOOKS

INTERNAL AUDITING IN INDUSTRY Edited by Victor Z. Brink and Bradford Cadmus. Published by the Institute of Internal Auditors, 120 Wall Street, New York. 404 pp. $5.

The various chapters of this volume outline the specialized internal control and internal auditing problems of a number of representative industries. It is assumed that the reader is familiar with the normal techniques, and the book is consequently concerned with the special and unusual requirements of the various subject industries. Chapter 5 is an introduction to the chapters dealing with the petroleum industry. Chapter 6 has to do with petroleum exploration and production. Chapter 7 with petroleum refining, and Chapter 8 with petroleum marketing.

Lube-Oil

BLENDING•PACKAGING•WAREHOUSING

at Sun Oil's Marcus Hook Refinery

THE new modern lube-oil packaging plant and warehouse at Sun Oil Co.'s Marcus Hook refinery resulted from an engineering study to improve blending, packaging, warehousing, and shipping facilities. At the time (May 1947) these operations were scattered throughout the refinery with additional warehousing facilities at Chester, Pa., approximately 4 miles from the refinery.

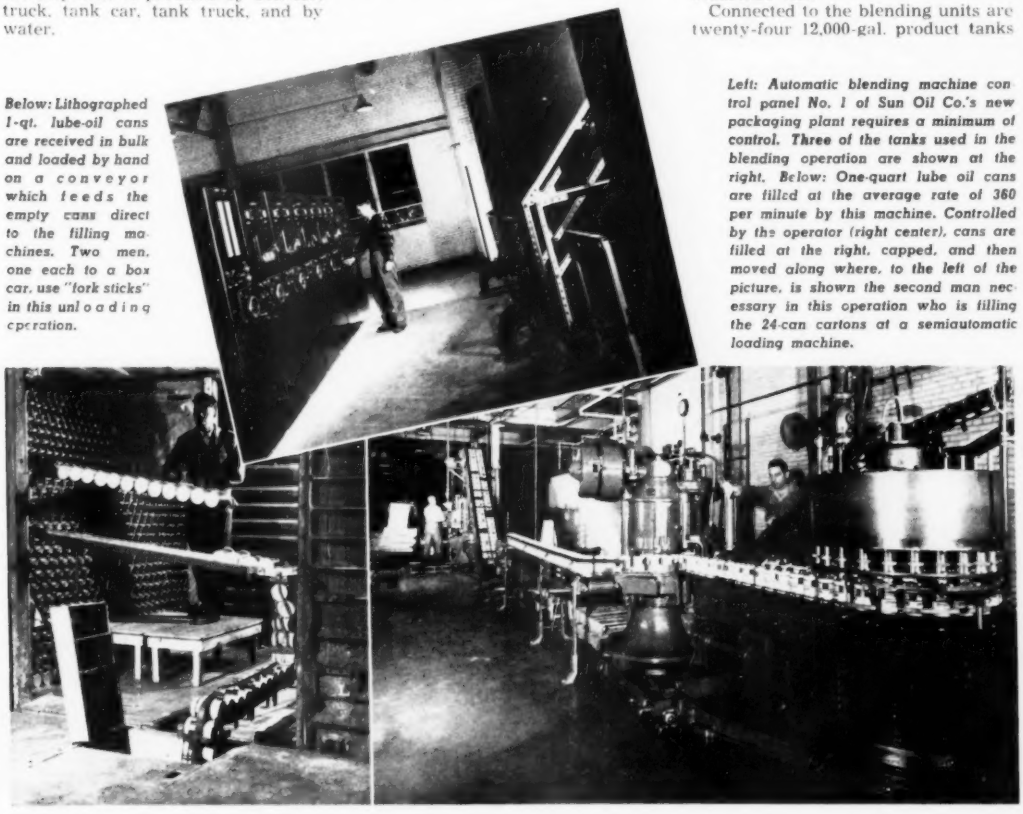
The study included type of structures, multistory versus one-story; the location and continuity of flow from base stocks to finished products; the choice of modern blending and packaging equipment to effect the most efficient operation; and providing for the efficient receiving of packaging and blending materials and the shipment of products by box car, truck, tank car, tank truck, and by water.

The existing floor and ground areas in use for these operations were found inadequate and the decision was made to build a new plant of adequate size on adjacent river-front property in the refinery. This resulted in the decision to house the blending and packaging operations in a two-story building, placing the filling equipment on the ground floor, and the administrative offices, the automatic blending machinery, and storage of empty cans and cartons on the second floor, and indicated a one-story warehouse for the storage of packaged products and empty drums designed for pallet stacking to a height of 20 ft.

The blending and packaging building is two stories, 140 by 440 ft. and has 14-ft. and 14-ft. 6-in. floor clearances respectively. It is of steel, reinforced concrete and buff brick construction, with all interior walls of white brick.

To the east and north of the blending building are located 90 base-stock tanks having a total capacity of approximately 660,000 bbl. These tanks range from 10,000 to 500-bbl. capacity, 51 of which are 10,000-bbl. units, and are connected to the pumps in the blending section. In this section on the second floor of the building, are located three continuous blending units, one five-component of 350 g.p.m. capacity for high-v.i. oils, one seven-component of 350 g.p.m. capacity for low-v.i. oils, and one five-component of 250 g.p.m. capacity for industrial oils.

Connected to the blending units are twenty-four 12,000-gal. product tanks



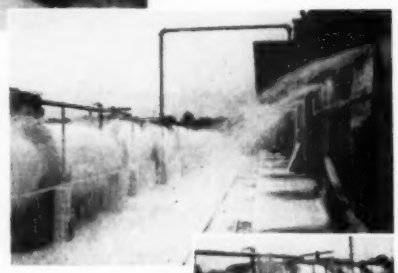
Below: Lithographed 1-qt. lube-oil cans are received in bulk and loaded by hand on a conveyor which feeds the empty cans direct to the filling machines. Two men, one each to a box car, use "fork sticks" in this unloading operation.

Left: Automatic blending machine control panel No. 1 of Sun Oil Co.'s new packaging plant requires a minimum of control. Three of the tanks used in the blending operation are shown at the right. Below: One-quart lube oil cans are filled at the average rate of 360 per minute by this machine. Controlled by the operator (right center), cans are filled at the right, capped, and then moved along where, to the left of the picture, is shown the second man necessary in this operation who is filling the 24-can cartons at a semiautomatic loading machine.

TOP: General view of the protected area.

CENTER: Foam discharge at the rate of 2 in. per min.

BOTTOM: Area covered by 6 in. of foam blanket in 3 min.



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PROTECTION FOR INDUSTRY

For many years fire protection engineers have been faced with the problem of finding a feasible answer to the hazard caused by crowded plant facilities where flammable liquids are involved. Conditions of this type exist in many chemical processing industries, metal working plants, petroleum storage and handling and electric power generation properties. A severe hazard was evident at the Schenectady Varnish Company, Schenectady, N. Y., where fire at the tank car loading racks and storage facilities presented a constant threat to the operation of the entire plant.

Having had a background in the development of all types of automatically operated fire protection equipment, "Automatic Sprinkler" engineers designed and installed the mechanical foam system, test photos shown above, and which is now commercially identified as "Automatic" AER-O-FOAM.

The important engineering advantages of this form of protection are evident in the improvement of drainage conditions, reduction of water supply requirements, non-corrosive action of the foam material, positive fire extinguishment and prevention of reflash. As "Automatic" AER-O-FOAM dehydrates rapidly following application, clean-up operations are held to a minimum.

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into which the blended oils are discharged and temporarily held for laboratory approval. In addition, there are nine mixing tanks, ranging in size from 6,000 to 250 gal., equipped with mechanical mixing devices for the compounding of specialty oils and small orders. The blending section is designed to blend approximately 350 finished products.

The blended oils are pumped from the product tanks to drum fillers, can packaging equipment, tank-car, and tank-truck loadings. The blending machines are also piped to discharge the blended oils directly to tank cars and tank trucks when desired.

The drum-filling section of the building is to be equipped with four filling conveyor lines. The empty drums are conveyed either directly from cars, trucks, or from storage to drum-filling room. The incoming conveyor lines are equipped with inspection station, stenciling booths, and drum-filling stations. Two of the filling conveyor lines are equipped with weight fillers designed to fill two drums simultaneously at the rate of 100 55-gal. drums per hour.

The third conveyor line is powered and equipped with single-scale filler capable of filling from 50 to 100 55, 30, and 15-gal. drums per hour. The fourth is equipped with a single meter filler for electrical and specialty oils. The four lines total approximately 2,400 drums per 8-hour shift.

In the western portion of the building, first floor, are located the 1-qt., 5-qt., 1, 2, and 2½-gal. and 5-gal. machine filling lines having the following capacities.

	Designed capacity		Operating rate, 85 per cent	
	cans	gal.	cans	gal.
Fillers	per min.		per min.	
1 qt.	360	90	312	78
5 qt.	50	62½	42½	53
1, 2, 2½ gal.	30	60	25½	51
5 gal.	20	100	17	85

The 1 and 5-qt. lines are equipped to receive the empty cans by separate conveyor directly from the bulk-loaded cars to the filling machines. The filled cans are then conveyed to the can sealer, carton packer, carton gluer, and then to the pallet loader. The conveyors ahead of the pallet loader are so designed to accommodate a full pallet load or more as required of the filled cartons from each of the 1 and 5-qt. lines. These are then fed to the loader as fast as full pallet loads are accumulated, changing from one size to the other automatically. The filled cartons are piled on the pallet by the loader in accordance with a predetermined pattern. The full pallet is then discharged at floor level and is transported directly to shipping or storage by fork trucks and trailer trains.

The empty 1, 2, and 2½-gal. cans are conveyed from second-floor storage to the filler. The 2 and 2½-gal. cans are machine filled and then

conveyed to the automatic inner sealer, capper, carton packer, gluer, and then to a second automatic pallet loader which operates similarly to the loader on the 1-qt. line. When filling the 1-gal. cans, they are conveyed from the capper to the 5-qt. packer, which lends itself to this operation. The 1-gal. and the 5-qt. fillings are scheduled separately.

The 5-gal. cans are conveyed from storage on the second floor of the building. They are machine filled, but because of their various shapes are not adaptable for automatic handling. They are capped and palletized by manual operation.

The tank-car loading facilities will consist of 10 tank-car spots and are so piped that the bulk shipments can be made directly from the blending machines or from the product tanks.

Two tank-truck loading spots will be provided with two tanks each of 4,500-gal. capacity, and each is equipped with a 250-gal. pump for quick loading. These tanks are required for laboratory control and for the temporary storage of finished lubricating oils awaiting truck arrivals. Tank trucks also can be filled directly from the blending machines or from the products tanks in the blending building.

The warehouse is designed for the storage of all types of filled packages and for empty drums. It is a one-story building with a 20-ft. clear height, 420 ft. long by 246 ft. wide. The roof is supported on steel columns 61 ft. 6 in. on centers across the building, and on 20-ft. centers longitudinally. Spacing was designed to accommodate 40 by 48-in. pallet piles.

The finished packages are transported by fork-lift truck or trailer trains from the packaging department directly to box-car and motor-truck shipping or to storage.

The warehousing space provided is for the accumulation of controlled stock quantities. This control is effected by the use of a daily I.B.M. inventory and is an integral part of the designed operation of the packaging plant. In other words, the storage facilities become the control for the packaging operation. This permits more economic filling since the packaging units and drum filler can be operated on one type of oil for longer periods.

A wholly enclosed car unloading and loading platform is located north of the packaging section. It includes two tracks with a 20-ft. wide concrete platform between, accommodating a total of 15 box cars. This area is 384 ft. long by 54 ft. wide, and provides all-weather unloading by conveyor of bulk shipments of 1 and 5-qt. cans directly to the filling machines. All other packages and carton materials are handled by separate conveyor directly to the second floor of the packaging building for storage.

To the west of the warehouse there is a sheltered platform parallel to which there are three tracks for the unloading and reloading of box cars. At the south end of this platform is constructed the empty drum conveyor to transport drums: (1) directly from the cars to the drum filling operations; (2) from the cars to storage; or (3) from storage to the drum-filling operation.

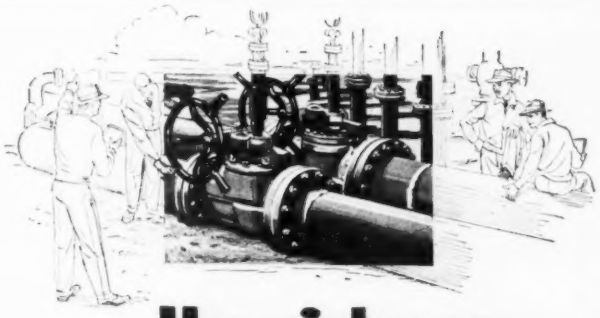
To the north of the warehouse is a covered truck shipping platform designed to accommodate approximately 18 highway carriers.

As a temporary measure, awaiting a more favorable pallet transportation rate from the carriers, the packaged products are being manually loaded from the pallet into box cars or trucks.

To the south is a wharf where facilities have been installed for the loading of lighters with palletized cartons and drums. These unit loads are transported from the warehouse to the wharf by trailer train and from this point handled and stowed on barges or lighters by fork trucks.

For ship loadings, the transfer from the lighter is made by using the ship's gear equipped with a special pallet grab. The cargo is stowed by an air-driven fork truck.

Plans for the modern lube-oil packaging plant and warehouse were developed by the company's engineering division, manufacturing department, with W. W. Lindsay & Co., Inc., as consulting engineer and general contractor.



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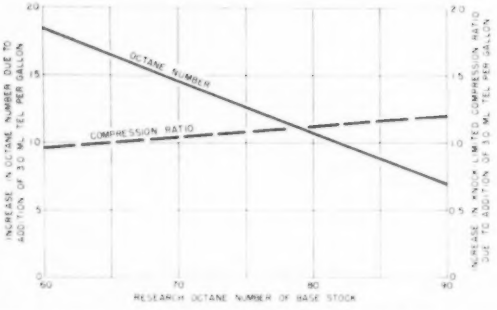
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INCREASE IN OCTANE NUMBER DUE TO ADDITION OF 3.0 ML TEL PER GALLON
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RESEARCH OCTANE NUMBER OF BASE STOCK

Fig. 1—Octane number gain and compression ratio increase permitted by adding 3 ml. TEL to normal base fuels of various octane levels.

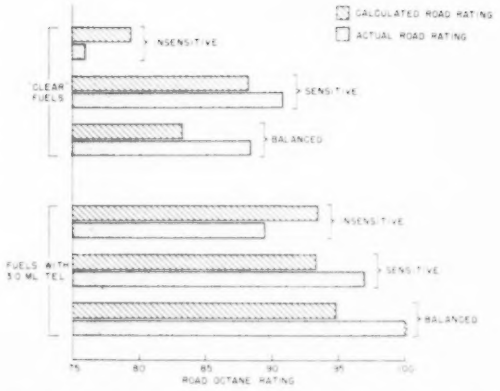


Fig. 2—Comparison of calculated and actual road knock ratings for three widely different types of fuel.

by John S. Wintringham

Improving

ROAD ANTIKNOCK RATING OF FUELS

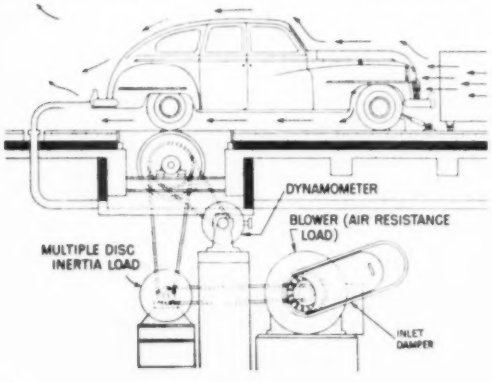
SOME fuels depart considerably in their knock behavior in cars and trucks on the road from the behavior which would be predicted from their knock ratings in laboratory engines. The research laboratories of Ethyl Corp. observed that a few exceptional fuels had the very desirable characteristic of rating higher on the road than would be anticipated. The research laboratories found that it was possible to synthesize fuels having this property to an even more pronounced degree. Subsequently such fuels have been called "balanced," since several properties and requisites are brought into balance in the antiknock performance of these fuels.

Automobiles in current production are more critical in their fuel requirements, and the problem of making fuels that will give best performance in these cars is one of the most important which refiners face. In recognition of this problem, the Ethyl laboratories have improved the previously installed equipment and set up new equipment designed to facilitate the production of test quantities of fuels having widely differing compositions, and have developed and improved testing techniques for the accurate evaluation of such fuels under service conditions.

For most current commercial fuels, the combination of A.S.T.M. research method and A.S.T.M. motor method

John S. Wintringham graduated from the Harvard Engineering School in 1930 with a degree of bachelor of science in mechanical engineering. He joined the Detroit research laboratories of Ethyl Corp. immediately. In 1935 he helped set up at San Bernardino, Calif., the road-test laboratories for Ethyl. In 1942 he returned to the Detroit laboratories, where, in 1947, he became associate director in charge of automotive-products research.

Fig. 3—The chassis dynamometer rolls are connected to an adjustable flywheel, made up of sets of demountable disks, which substitute for the inertia of the car on the road. A blower also connected to the rolls simulates air resistance. The air temperature may be adjusted to any desired value from 150° F. to below 0° F.



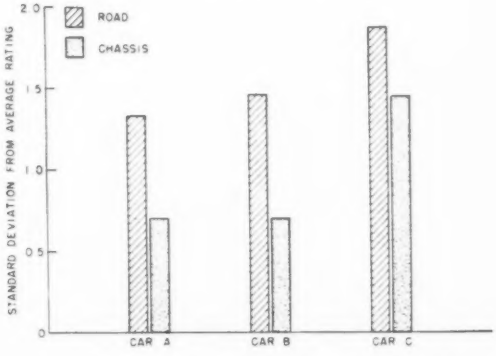


Fig. 4—Standard deviations of knock ratings of several fuels in three cars on the road and on the chassis dynamometer.

TABLE 1—LABORATORY AND CALCULATED ROAD KNOCK RATINGS FOR THREE WIDELY DIFFERENT TYPES OF FUEL

Fuel type—	TEL (ml./gal.)	Octane number— Motor	Octane number— Research	Lead response— Motor	Lead response— Research	"Jump," or research minus motor rating	Calculated road rating*
Insensitive	0	79.6	79.1			—0.5	79.5
	3.0	93.7	93.1	14.1	14.0	—0.6	93.5
Sensitive	0	79.4	92.1			12.7	88.3
	3.0	84.0	97.3	4.6	5.2	13.3	93.3
Balanced	0	79.8	84.9			5.1	83.3
	3.0	90.1	97.0	10.3	12.1	6.9	94.9

*Road rating is calculated by adding 70 per cent of the jump to the motor method rating.

ratings of a fuel gives an approximate indication of its average road knock rating in the average car or truck. The research rating minus the motor rating gives a figure called sensitivity or "jump." The road rating is generally between the two A.S.T.M. ratings, being closer to the research rating. An insensitive (straightrun) fuel has only a small or negative jump, but generally has good lead susceptibility (large increase in octane rating for given additions of tetraethyl lead). Sensitive fuels have a large jump, but usually poorer lead susceptibility.

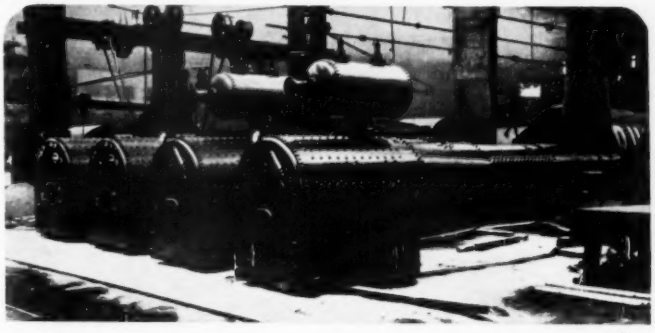
During the last two decades, most commercial base fuels have become more sensitive as the proportion of straightrun has been reduced. In the course of this step the octane rating of the base fuels has moved upward considerably. It is important to realize that this progress has involved a reduction in the number of octane units gained by addition of a given amount of tetraethyl lead, but that the value of each unit is larger at the higher level.

Fig. 1 shows the increase in octane number due to addition of 3.0 ml. tetraethyl lead per gallon of representative fuel at each octane level over the range of research octane numbers from 60 to 90. At each octane level the increase is shown in knock-limited compression ratio due to the lead. From this curve it is apparent that the change in nature of the base fuels from essentially insensitive at the 60-octane level to rather highly sensitive at the 90 level has caused a parallel reduction in gain in octane numbers due to lead, but that the actual usefulness in terms of engine parameters has increased.

Experimental fuels of the balanced type have been put together in the Ethyl laboratories. One such fuel has only a moderate difference between the two A.S.T.M. ratings, has good lead susceptibility, and has an unusually high knock rating on the road. This fuel rates on the road above the higher A.S.T.M. rating (the research rating).

Table 1 lists motor and research ratings for clear and leaded fuels of three types: insensitive, sensitive, and balanced. The high lead response and the very low jump of the insensitive fuel are contrasted to the low lead response and high jump of the sensitive fuel. The balanced fuel has good lead response and moderate jump. Table 1 also shows calculated road octane ratings for these fuels. Fig. 2 shows actual road ratings of these fuels. The insensitive fuel, both unleaded and leaded, actually rates on the road below its calculated road rating. The sensitive fuel rates about three octane numbers above the predicted values, and the balanced fuel rates more than five numbers above the calculated ratings. The balanced fuel actually rates on the road above the research rating by four octane numbers.

Anything that may be accomplished with economy towards making fuels having the characteristics described above is advantageous. For the purpose of studying the possible ways of combining fuel components



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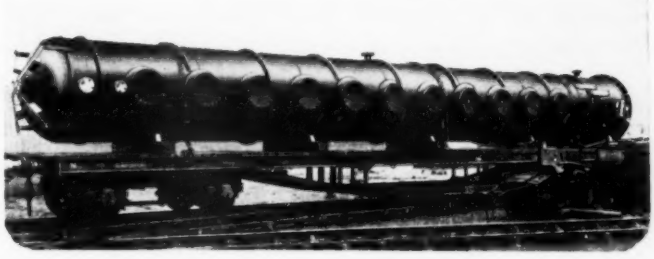

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to produce a balanced fuel, Ethyl is presently using a pair of batch stills whose construction was finished early this year. These stills permit cutting gasoline into component fractions which may be blended in any desired combinations for studies of the effect of variation in composition on engine knocking. Both stills are made largely of stainless steel, and are electrically heated. One has a charge capacity of 165 gal. and a column efficiency of about 15 theoretical plates. The other has a charge capacity of 65 gal., and a column efficiency of about 25 theoretical plates. Used together, the stills permit cutting a fuel into fractions boiling over a narrow range.

Since A.S.T.M. ratings are unable to predict the road behavior of these unusual fuels, their performance must be assessed by actual road tests, or a suitable substitute. Varying weather conditions and the difficulty of making observations on crowded highways make road knock ratings less reliable and more hazardous to obtain than is desired.

For some years the research people in the Ethyl laboratories have, therefore, been developing and using chassis dynamometers for "road" knock ratings. An example is shown schematically in Fig. 3. Loading of the chassis rolls is arranged, by selection of the inertia of the rotating mass or by changes in the electrical loads, to control acceleration of a car through its speed range. With its throttle wide open, a car accelerates from low to high speeds at precisely the rate which would exist on the road. Cooling air for the radiator is blown against the front of the car at a varying rate which increases with car speed, so that air and other engine temperatures under the hood of the car on the chassis dynamometer behave as they would on the road. It is possible to control the temperature and humidity of the air in the chassis dynamometer rooms within rather close limits so that conditions may be provided for duplicating readings from day to day and month to month.

Tests involving 258 ratings of fuels in three cars have shown that there is less variability from rating to rating made on the chassis dynamometer under these closely controlled conditions than occurs in carefully run road tests. Fig. 4 shows the standard deviations of ratings from the average rating, and indicates that in all three cars the deviation was less on the chassis dynamometer than on the road. The average rating on the chassis dynamometer was 0.1 octane number higher than the average on the road. This difference is so small that the ratings are considered equal.

Merely knowing that certain combinations of hydrocarbons exhibit the unusual characteristics of a balanced fuel is not enough. It is very important to know why. Tests on a fuel

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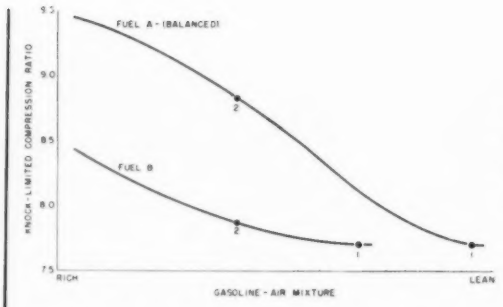

Fig. 5 — Variation of knock-limited compression ratio with fuel-air mixture ratio for two fuels which differ greatly in rich-mixture response.

which has shown the balanced qualities have been run in a single-cylinder, variable-compression engine over a wide range of air-fuel mixture ratios. Data are shown in Fig. 5, where the knock-limited compression ratio is plotted against the fuel-air mixture ratio. Data for a balanced and normal fuel are shown. Both fuels have the same minimum compression ratio, at points marked 1 (maximum-knock fuel-air ratio), and both would be assigned the same single-cylinder knock rating. Fuel A, however, permits higher compression ratios at richer mixtures. If both fuels are operated at mixture ratio marked 2, fuel A is roughly one compression ratio better.

During knocking conditions, car engines normally operate in a mixture range richer than maximum knock. For this reason the rich-mixture behavior of the balanced and other fuels may be of particular interest.

Other work aimed at finding why multicylinder-engine ratings differ from single-cylinder ratings involves finding how a fuel is distributed to the several cylinders of multicylinder engines. Of interest is not only how much fuel reaches each cylinder, but what is the composition of the fuel in each cylinder. Engine design and operating conditions are as important as fuel properties in this work.

Eventually it may be possible to tailor fuels which distribute anti-knock value as needed. In this regard, consideration should be given to the difference between fuel distribution in an engine while the speed

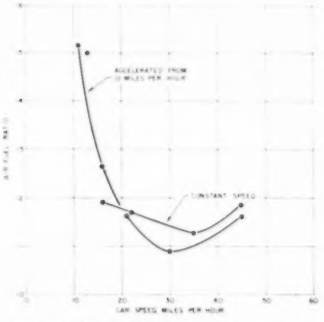

Fig. 6—Relation between air-fuel ratio and car speed during acceleration and at constant speeds.

is changing rapidly in accelerating the vehicle, and fuel distribution during constant-speed operation. Fig. 6 shows average over-all engine air-fuel mixture ratios over the engine-speed range while accelerating from 10 m.p.h. and during constant-speed operation. Early in the acceleration some of the fuel from the carburetor lags in the inlet manifold and does not reach the cylinders, which therefore operate with a lean mixture. At a higher speed the fuel which lagged behind during the lower-speed operation is carried into the cylinders,

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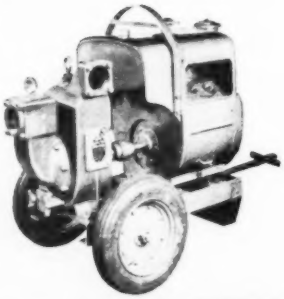

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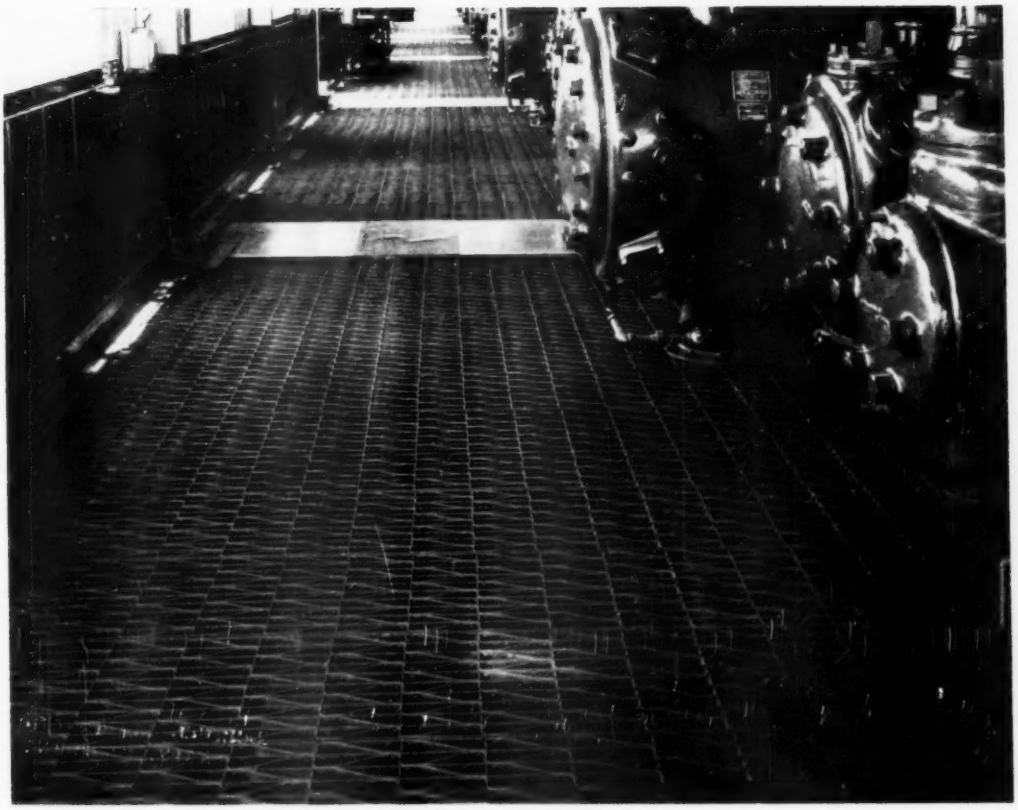

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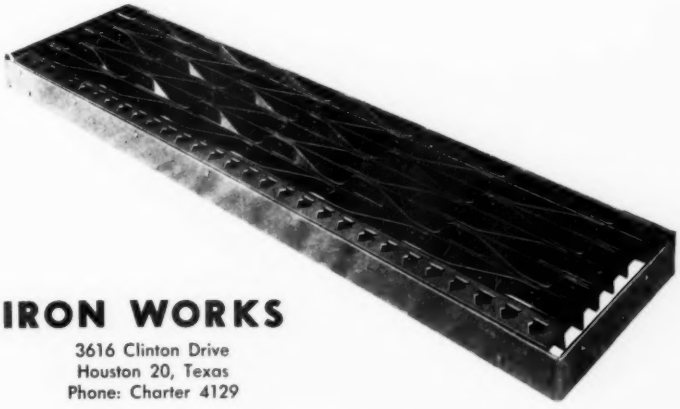
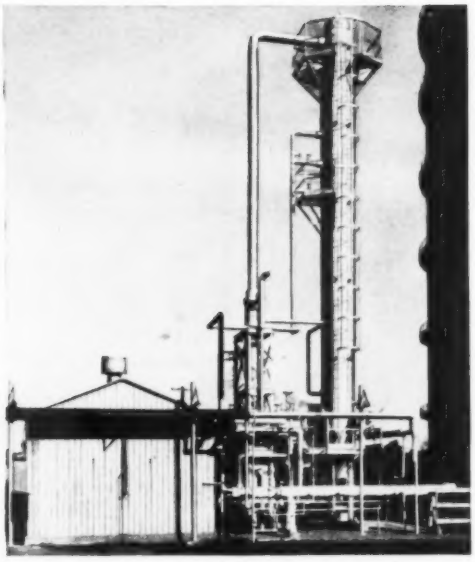


ARROWHEAD IRON WORKS

1010 Gentry
North Kansas City 16, Mo.
Phone: NOrclay 3121

3616 Clinton Drive
Houston 20, Texas
Phone: Charter 4129



SMALL but IMPORTANT

...to you and to us

With Blaw-Knox, small projects receive the same engineering care as do large ones. Each problem is a matter for careful consideration by a separate department employing engineers of broad general experience. This group can handle a small job much more economically, because there is no overlapping or duplication of effort.

When satisfied that designs and specifications exactly meet the customers' needs, our field construction force builds the plant in minimum time and turns it over "on stream." Glad to show you some interesting figures on our Gasoline Stripping Plants and related projects for the gas and oil industry.

OIL and GAS DEPARTMENT

CHEMICAL PLANTS DIVISION

BLAW-KNOX CONSTRUCTION CO.

321 Penn Ave., Pittsburgh, Pa. • 1341 South Boston, Tulsa, Okla.

making them richer than would be the case for constant-speed operation.

Speculation is interesting with respect to proper division of antiknock quality over the boiling range of a gasoline, since the fuel portions which lag behind are the higher-boiling fractions. It seems unlikely that antiknock value should be distributed evenly throughout the whole fuel for most effective road performance.

The new equipment and the fast-developing techniques described above all will play a part in the search for better fuels at low enough cost to make their use economically justified.

Propane Deasphalting At Utah Oil Refining Co.

(Continued from page 218)

from 100° F. to 260° F. The value of this flexibility in balancing residual fuel and in producing road oils and asphalts to meet peak summer demands is illustrated in Fig. 2. For example, when producing 250 softening point asphalt the yield of No. 6 fuel from this source is only 47 per cent of the yield of No. 6 fuel when producing 150 softening point asphalt. A similar effect is shown for a typical road oil, SC-3, and for a typical penetration asphalt.

The asphalt produced on the deasphalting unit has been blended into quality asphalt products ranging from SC-grade road oils to penetration-grade asphalts (asphalt cements). A blending plant for blending cutback asphalts and penetration asphalts is being built to facilitate marketing these products. The ease with which the unit may be shut down or started up and the low manpower requirements fit in with the operations of a small, complete refinery.

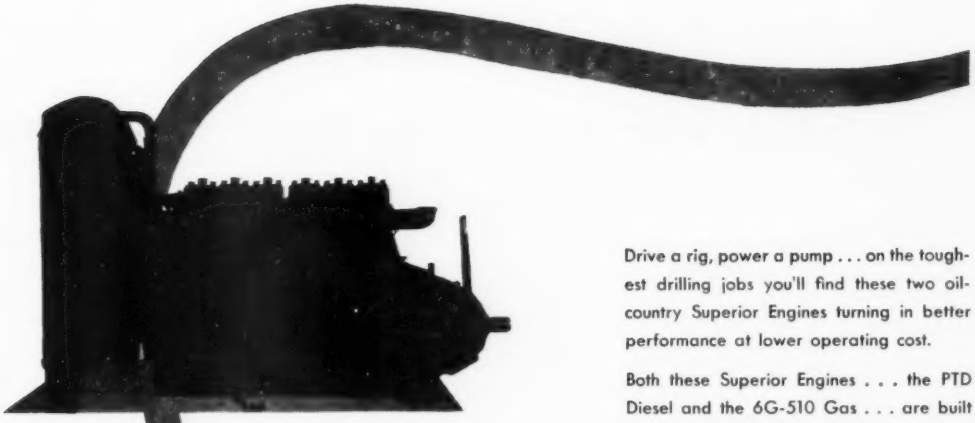
Acknowledgments

The propane deasphalting unit installed at Utah Oil Refining Co. was designed and constructed by M. W. Kellogg Co. of New York City. The pilot-plant work in which Rangely reduced crude was deasphalted in a tower-type contactor was also carried out by Kellogg under joint agreement between Kellogg and Utah. We wish to express our appreciation of the cooperative spirit with which personnel of the Kellogg company performed all of the tasks involved in this project.

BOOKS

ANNUAL REPORT OF THE DEPARTMENT OF LANDS AND MINES OF THE PROVINCE OF ALBERTA. Published by the order of the Legislative Assembly, Edmonton, Alta. 136 pp.

This report, for the fiscal year ended March 31, 1949, covers Lands Administration, Forestry Administration, Fisheries and Game Administration, Mining Lands Administration, Technical Division, Accounts Administration, and Registration Division.



Superior 6G-510
Gas Drilling Engine

DESIGNED FOR
THE TOUGH ONES

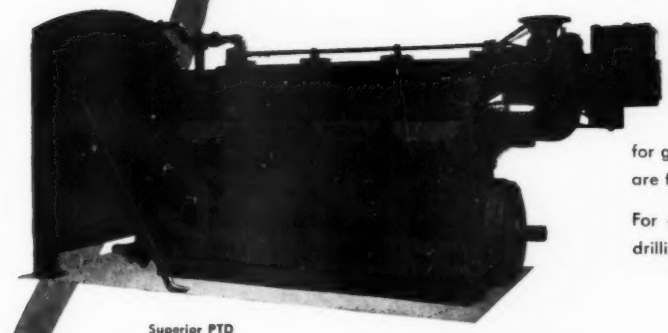
SUPERIOR ENGINES

Drive a rig, power a pump . . . on the toughest drilling jobs you'll find these two oil-country Superior Engines turning in better performance at lower operating cost.

Both these Superior Engines . . . the PTD Diesel and the 6G-510 Gas . . . are built specially to handle oil-field work. They give the driller a power plant that's fast on acceleration, responsive to load changes. They're dependable on the long pull, simple to maintain. And they're efficient, low-cost engines to operate.

Choose a Superior PTD Diesel Engine in sizes from 280 to 620 horsepower, either naturally aspirated or supercharged. You can also get the dual-fuel feature on the naturally-aspirated model . . . move a lever to switch from diesel fuel to gas for greater economy where field conditions are favorable.

For a gas engine specially designed for drilling, pick the 300-HP Superior 6G-510.



Superior PTD
Diesel Drilling Engine

THE NATIONAL SUPPLY COMPANY
GENERAL SALES OFFICES: TOLEDO, OHIO
NATIONAL BLUE PRODUCTS

DIVISION OFFICES: CASPER; FT. WORTH; PITTSBURGH; TULSA; TORRANCE.
CANADA: THE NATIONAL SUPPLY COMPANY, LIMITED, ROOM 202, ALBERTA BLOCK, CALGARY, ALBERTA.
EXPORT: NATIONAL SUPPLY EXPORT CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK, N. Y., U. S. A., RIVER PLATE HOUSE, 12 SOUTH PLACE, LONDON, E. C. 2

Petroleum Refining Maintains High Degree of Stability, Despite Shifting Product Demands

by John C. Casper
District Editor

PETROLEUM refining is a stable industry. Volume throughput tends to vary less during periods of change in our national economy than does total production from all manufacturing plants. In the past, the refining industry has operated between a floor of increasing demand for finished petroleum products and a ceiling of maximum crude productive capacity. These have tended to reduce deviations from a general trend line for the past 25 years.

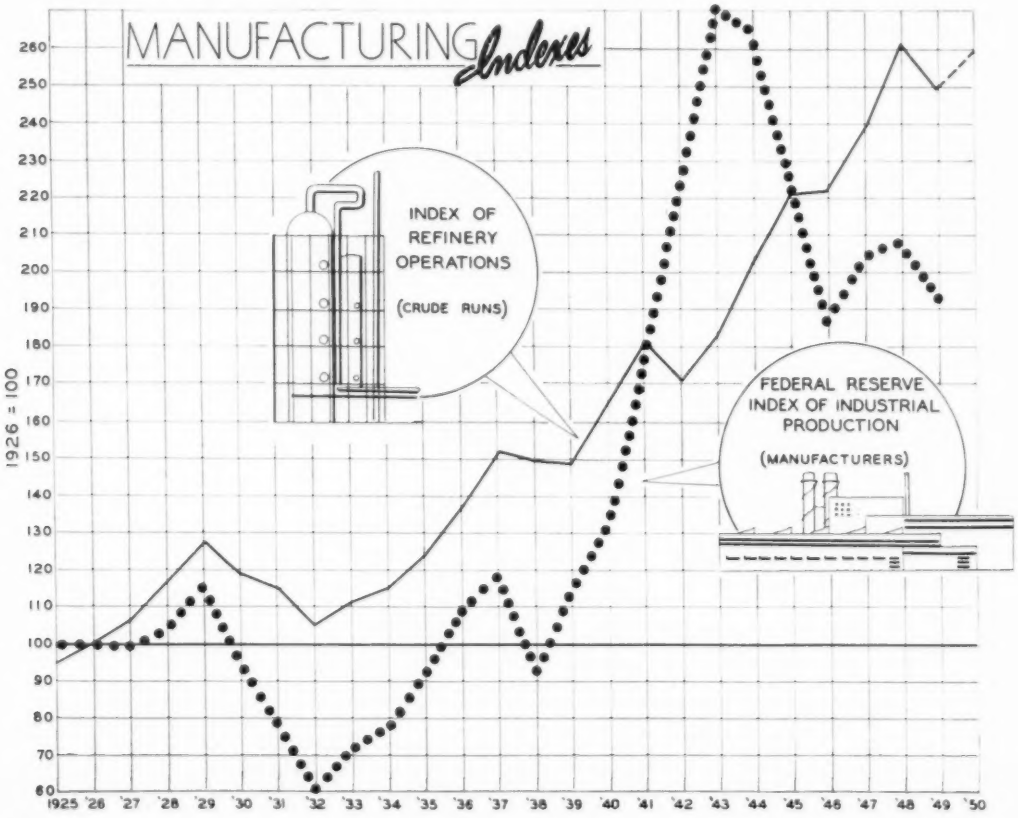
In the chart on this page, refinery operation is plotted as an index based on crude runs for each year since 1925 with the runs for 1926 taken as 100. This is charted for comparison with the manufacturing portion of the Federal Reserve index of industrial production which is a measure of volumetric output for all manufacturing plants of all types in the country.

It is worthy of note that refinery operations remained more stable during the depression years than manufacturing operations in general. Total production by all manufacturing plants dropped rapidly in 1930, 1931, and 1932 to reach a low point of about 60 per cent of the 1926 average. In contrast, refinery output never dropped below the 1926 average. The short recession of 1938 which caused a sharp dip in total manufacturing did little more than cause a temporary leveling off in the refining industry. This resistance to sharp declines is based on a steady gain in civilian, commercial, and industrial demands for petroleum products.

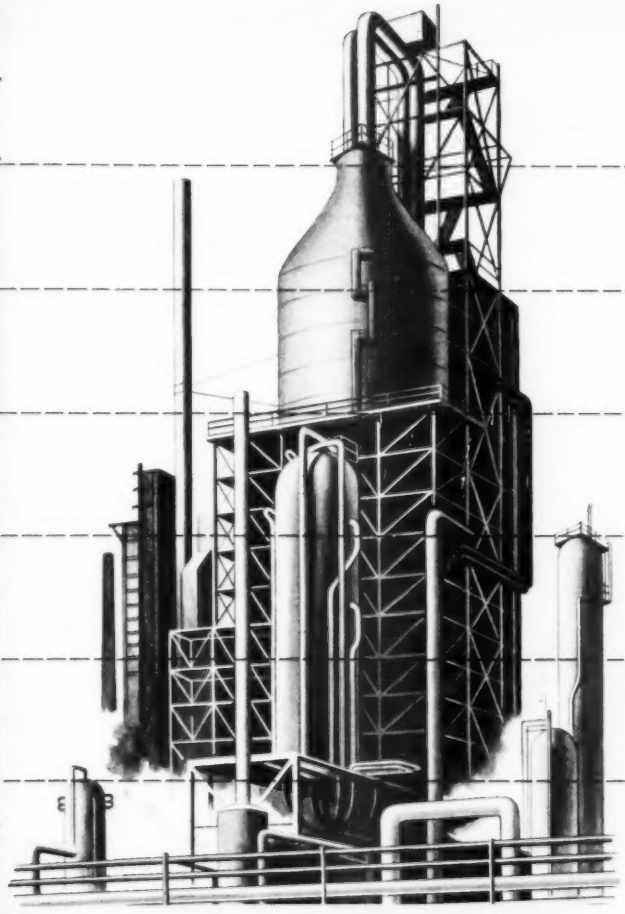
During the war years when the total manufacturing index went up to 272, petroleum refining increased gradually and was still going up for 3 years after the war ended. The slight dip in 1942 was due to a transportation shortage when submarine warfare reduced Gulf-East Coast tanker shipments.

Readjustments in 1949. — The postwar readjustment period for refining did not come until 1949. The big increase in refinery runs for 1948 was exceeded only by the wartime increase in 1944 but about 212,000 bbl.

(Continued on page 297)



FACTS About Du Pont's Helpful Services to the Refiner



RESEARCH

TECHNICAL

MARKETING

SAFETY

MEDICAL

FIELD LABORATORY

DU PONT

Better Things for Better Living
. . . Through Chemistry

USE DUPONT TETRAETHYL
LEAD COMPOUNDS

How Du Pont TEL Services can help you

RESEARCH

What petroleum chemicals research facilities does Du Pont have?

Du Pont maintains a complete research department devoted to the study of fuels and their components, both from a chemical and an engineering standpoint. Center of the Petroleum Chemicals research effort is at Deepwater, New Jersey. Road test fleets operate out of this headquarters as well as out of the El Monte, California Road Testing Laboratory.

What other research facilities does Du Pont have?

In addition to the research carried out in the Petroleum Chemicals laboratories, specific projects are maintained in the company's experimental station for which a new $30,000,000 building project is nearing completion in Wilmington. The findings of other laboratories throughout the company are available at all times for consideration as to their application to the petroleum industry.

What are the objectives of Du Pont Petroleum Chemicals research?

Du Pont has initiated a long-range program of fundamental research leading to a better understanding of the combustion process and its chemical control. A wide variety of studies are under way to help refiners utilize present TEL compounds most efficiently. Others are aimed at improving antiknock compounds. Research is also conducted on other gasoline additives.

TECHNICAL

What Technical Service does Du Pont offer?

Du Pont provides an integrated technical service that works with refiners, equipment manufacturers and fuel users.

Does their work treat with refinery operation?

Du Pont's men are fully trained in the various phases of refinery work and are able to consult with your management, research and development groups, not only upon problems related to the most efficient utilization of TEL Compounds, but also upon refining and treating processes that relate to the use of additives.

Is Du Pont prepared to offer further technical services?

Du Pont Technical Representatives will keep you advised on the latest technological developments in the refining and additives field and will work with you toward their incorporation into your own processes. They will also assist in training personnel in precision test methods.

Does Du Pont consult with automotive manufacturers?

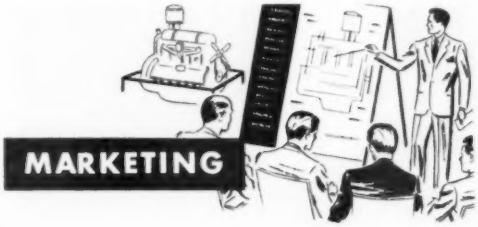
Yes. Du Pont has a staff of experienced engineers whose function it is to consult with research and technical groups of automotive manufacturing companies on problems related to the utilization of leaded fuels and other problems concerned with design and engine performance.

Does Du Pont also consult with tractor, truck, bus, aircraft engine and other manufacturers?

Du Pont works with all types of engine manufacturers on problems to improve engine-fuel relationships and on problems associated with the utilization of leaded fuels.

What other aids does Du Pont offer?

The results of Du Pont research are made available through the publication of papers and through joint meetings of Du Pont and refinery research personnel. By widespread dissemination of such information, Du Pont contributes toward the creation of better fuels and their more effective use.



MARKETING

What facilities does Du Pont offer to aid the refiner in his marketing program?

Representatives working out of the Du Pont District Offices are ready at all times to assist your marketing groups on specific promotional programs.

Can these men be called on to conduct meetings and help in educational work?

Yes. These representatives are available to work with

your own marketing group in conducting educational meetings among dealers and other personnel.

Does Du Pont supply information that will help a refiner evaluate the position of his fuels?

Du Pont provides a comprehensive quarterly gasoline survey which shows the octane rating and TEL content of individual gasolines in all geographical sections of the country.

Is Du Pont prepared to render assistance on automotive operational problems?

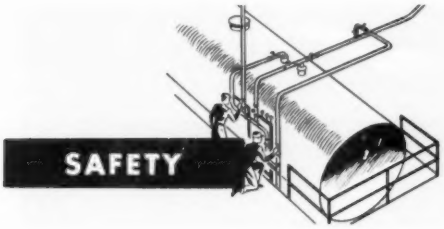
Du Pont's field engineers are always available to work with refiners and assist in applying preventive maintenance for truck, bus, tractor, and other automotive equipment operators.

How about aircraft engine operation?

These helpful field services are also available to work with airlines and airports on specific engine operating problems.

What about deliveries?

As the operator of its own fleet of tetraethyl lead tank cars, Du Pont has been able to maintain scheduled deliveries throughout the country.



Does Du Pont maintain a safety service for the benefit of those using Du Pont TEL Compounds?

Yes. It is made up of a group of specially trained men who can help you in many ways to insure the safe handling of tetraethyl lead compounds.

Can Du Pont help in making blending plant layouts?

Yes. Standard or special plans and specifications, as well as actual on-the-spot assistance, are provided in blending plant construction.

Does Du Pont help to train personnel for operation of the blending plant?

Yes. Du Pont will supply the type of training that results in safe employees and an efficient operation.

What does Du Pont provide in the way of inspection and maintenance supervision?

The safety services provide users of Du Pont TEL Compounds with a regular quarterly inspection service, assist in the application of preventive maintenance, and supervise any necessary maintenance and repair work. They will also advise on problems related to the cleaning and repair of tanks which have contained leaded fuels and will attend and advise on tank entries.

What about emergency field help?

On any problem involved in meeting emergency field conditions, Du Pont safety men will assist in working out a satisfactory solution.

What other services are offered by the Safety Group?

They will keep your personnel abreast of the latest approved methods of handling, circulating, and mixing TEL Compounds. They will work with your own laboratory personnel on problems related to the handling of TEL. In addition, they will help you in determining the adequacy and safety of your blending plant equipment and methods.

Does Du Pont supply a medical service in connection with the use of Du Pont TEL Compounds?

Yes. The Du Pont medical service comprises a group of physicians specially trained in industrial hygiene and particularly in the health problems that relate to the handling of tetraethyl lead compounds. They are always ready to cooperate with you in safeguarding the health of employees working with TEL Compounds.

Does the Medical Service aid in the selection of employees to work with TEL?

Yes. They will make preliminary health studies to determine employee suitability for work in these locations.

Does their responsibility end with the selection of the employee?

No. They will also make periodic examinations of such personnel to insure that proper hygienic standards are being maintained.

What other medical service is available?

In addition to examinations of employees, the medical service is, at all times, available to consult with you on general health problems concerning the employees whose work is associated with the handling of TEL Compounds.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . Through Chemistry

FIELD LABORATORY SERVICES

These services are provided by Du Pont District Laboratories in Wilmington, Delaware; Chicago, Illinois; Tulsa, Oklahoma; Houston, Texas, and El Monte, California. Complete laboratory service is available to help you determine the qualities of your fuels, their additive requirements, and also to serve as a dependable check on your own laboratory findings. In emergencies the laboratories will furnish data that will help you to control processes. These laboratories are prepared to offer you the following services in connection with the use of any one of the Du Pont Gasoline additives.

Make DuPont the Source for All of Your Gasoline Additives

TETRAETHYL LEAD COMPOUNDS

Laboratory services are available to you for supplying octane ratings on blending stocks, determining lead susceptibility of stocks and for checking the octane ratings and TEL concentration of your finished blends.

GASOLINE ANTIOXIDANTS

Provide laboratory evaluation services in determining which one of the *three* Du Pont Gasoline Antioxidants will work best with your fuel. Work with your own personnel in determining at which point in your refining process the addition of antioxidants will be most effective.

METAL DEACTIVATOR

They can furnish you with comparative data on the economies of using Du Pont Metal Deactivator in copper contaminated stocks to lower the cost of antioxidant treatment and improve storage stability.

GASOLINE DYES

Each District Laboratory is equipped to furnish complete information on color blending with Du Pont Gasoline Dyes to achieve any desired color characteristic.

DID YOU KNOW

Du Pont Serves the Petroleum Industry With Many Products

Du Pont products used by the petroleum industry are by no means limited to gasoline additives. For example, Du Pont supplies many special explosives for seismic prospecting and for "shooting" oil wells too. Then, there is neoprene, Du Pont's durable, oil resistant chemical rubber. This finds application in many pieces of equipment. Special finishes are also supplied for tank farms, bulk plants, and other oil equipment. These are only a few of the many Du Pont products that daily find use throughout the industry.

DuPont Services Help You Use Them Most Effectively

DU PONT

Better Things for Better Living
. . . Through Chemistry

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
PETROLEUM CHEMICALS DIVISION
Wilmington 98, Delaware

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

District Offices: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

daily of the 1948 increase was used to rebuild depleted stocks. This rebuilding at the end of the postwar expansion period tends to exaggerate the drop in the leveling-off year of 1949. All published forecasts of demand call for increased runs in 1950.

Although the growth of petroleum refining has been relatively steady for the past 30 years, there have been many changes within the industry. One of the greatest shifts resulted from change in demand by products. In the period from 1920 to 1930 the rapid increase in demand for motor fuel made it necessary to increase yields of gasoline from 26 to 42 per cent. In the same period, kerosine yields dropped from 12.7 to 5.3 per cent and the combined yields of distillate and residual fuels dropped from 48.6 to 40.2 per cent.

Distillate use expanded.—Since 1930, the big change in the yield pattern has been caused by the marked growth in the demand for home-heating and diesel fuels. Distillate yields from a barrel of crude increased from 8.8 per cent in 1930 to 18.7 per cent in 1948.

The growth in heating-oil demand has been responsible for a large part of the shift in total demand by seasons. Prior to 1940, the peak demands for petroleum products came in the summer months but in recent years this has been reversed with high demands coming in the winter quarters of the year. A new total-demand record was set in December 1949 despite lower-than-expected sales of distillate for heating.

The rapid expansion in heating-oil requirements has brought another refinery problem — storage during the summer months. Experiences of the past few years have shown that summer purchases for storage by resellers and consumers cannot be predicted. In 1948, these purchases were very heavy in May, June, and July but there was very little movement to reseller and consumer storage during the same months of 1949. Since refiners are not able to forecast this movement for a particular year, it will be necessary for them to provide enough tank space to handle most of the summer-time build up of distillate stocks.

Another factor affecting yields and other operations of refineries of a particular district is the type or quality of crude available. The chart at the bottom of the page shows a breakdown of 1949 yields by some of the major refining districts. California, where a high percentage of the crude is low-gravity, has the highest yield of residual and the lowest yield of gasoline. A decline in the demand for residual fuel in the area resulted in a rapid gain in heavy-fuel stocks during 1949. Since residual demands on the East Coast have been high this winter, some of the California surplus has been marketed in the east but at a low netback to West Coast refiners. Present plans call for a general reduction of residual yields at California refineries.

East Coast yields also have been affected by changes in type of crude used. The increase in imports of heavy Venezuelan crude, most of which has gone to East Coast refineries, has tended to reduce yields of gasoline in that district. Some refinery changes have been necessary with the increased use of sour crudes from West Texas and the Middle East.

Shifts in crude supply.—Certain refinery changes in the Illinois-Indiana district have resulted from shifts in crude sources. In 1939, about 35 per cent of the crude used by refineries in this district was produced within the two states. Over half of the crude came from Oklahoma and Kansas with only about 10 per cent supplied by Texas and New Mexico. By 1949, the Texas-New Mexico portion had grown to almost 50 per cent and the intrastate shipments had dropped to 11 per cent. Oklahoma-Kansas receipts had decreased to less than one-third of the total while supplies from other areas, mostly Rocky Mountain, had moved up to 6 per cent.

The major changes in processing during the past 10 years have been brought about by the quality-gasoline race. The movement toward higher compression ratios for automobile engines has been coincident with the improvement in antiknock quality of motor fuels and the increased use of catalytic cracking.

Competition is keen in the refining industry and most of the changes in design, size, and location of refineries have been made in order to give the consumer a better product at a lower price or to cut costs in a competitive market.

RUNS OF FOREIGN CRUDE
(Thousands of barrels daily)

	East Coast	Other	Total
1935	71	17	88
1936	84	9	93
1937	67	4	71
1938	66	6	72
1939	80	12	92
1940	91	23	114
1941	129	10	139
1942	36	4	40
1943	32	1	33
1944	118		118
1945	202		202
1946	231		231
1947	265	2	267
1948	326	13	339
1949	374	52	426

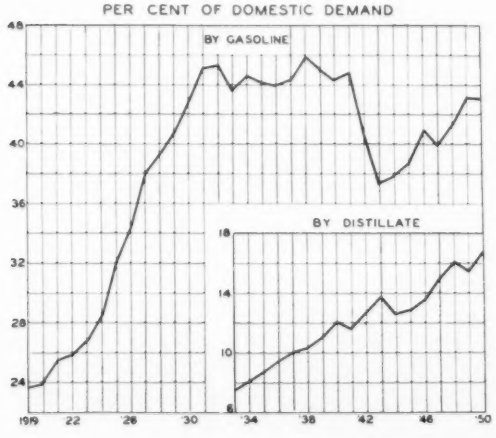
CRUDE RECEIPTS AT ILLINOIS-INDIANA REFINERIES BY AREA OF ORIGIN
(Per cent)

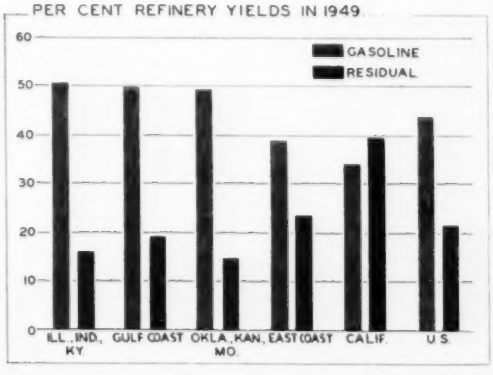
	1939	1949
Intra-area receipts	35.4	11.4
From Oklahoma-Kansas	52.4	32.6
From Texas-New Mexico	10.3	49.8
Other	1.9	*6.2
Total	100.0	100.0

*Principally Rocky Mountain crude.

CRUDE RECEIPTS AT REFINERIES, BY METHODS OF TRANSPORTATION
(Per cent)

	Tanker and barge	Pipe line	Tank car and truck	Total
1934	25.9	71.2	2.9	100
1939	23.8	72.9	3.3	100
1944	9.9	83.3	6.8	100
1949	24.6	73.7	1.7	100





Current Status of Synthetic Rubber Butadiene Plants

CURRENTLY, 4 of the 14 government war-built petroleum butadiene plants are still in production. These plants, having a total design capacity rating of 241,200 short tons yearly, are located in Louisiana and Texas and are operated by oil companies for the account of Office of Rubber Reserve.

Four of the wartime-operated plants are now on standby status and two are declared surplus. The other four of the original group have been sold.

Operating Plants

Lake Charles, La.—This plant, rated at 55,000 short tons annual capacity, is operated by Cities Service Refining Corp. Feed stock for the plant's operation is obtained via pipe line from nearby Cities Service refinery in the form of a mixed hydrocarbons stream. Catalytic dehydrogenation is employed for converting normal butylene to butadiene. The copper ammonium acetate process is used for purification of the product which is transferred to an adjacent copolymer plant operated by Firestone Tire & Rubber Co.

Baytown, Tex.—Feed for this plant is supplied by pipe line from the adjacent refinery of Humble Oil & Refining Co., which company also operates the butadiene installation. Processing facilities include, generally, catalytic dehydrogenation and copper ammonium acetate purification. The product is shipped by pipe line to the nearby copolymer plant operated by General Tire & Rubber Co. Design capacity rating on the plant is 30,000 short tons per year.

Port Neches, Tex.—Ownership and operation (on a nonprofit basis) of this plant is made up of five oil companies—Texas Co., Atlantic Refining Co., Gulf Oil Co., Pure Oil Co., and Socony-Vacuum Oil Co., Inc., forming Neches Butane Products Co., operator of the plant. Feed stock, normal butylene in the form of a mixed stream of hydrocarbons, is supplied via pipe line from refineries of the five participating companies located nearby. Conversion of normal butylene to butadiene is by catalytic dehydrogenation and the furfural process is used for product purification. Transfer of product to adjacent copolymer plants operated by Firestone Tire & Rubber Co. and B. F. Goodrich Chemical Co., is by pipe line. Butadiene production capacity on a design basis for this plant is 100,000 short tons annually.

Borger, Tex.—Phillips Petroleum Co., operator of this plant, employs its own process for the conversion of butane to butylene and thence to butadiene. Catalytic dehydrogenation is used in these two principal steps and product purification is with the furfural process. Feed material is natural gas from fields in the area. Product is shipped by pipe line to the adjacent copolymer plant operated by Goodrich Chemical. Butadiene capacity of the plant is 56,200 short tons per year, design basis.

Standby Plants

Los Angeles.—This plant was operated on a feed stock of crude butadiene produced at a nearby plant operated by Southern California Gas Co., which is now listed as surplus. Shell Chemical Division of Shell Union Oil Corp., now Shell Chemical Corp., as agent for Rubber Reserve operated this crude-butadiene processing plant. Facilities designed for the plant provided purification capacity for 55,000 short tons of butadiene annually, 30,000 tons of which were extracted from the crude stream. The remainder, 25,000 tons annual capacity, was produced by catalytic dehydrogenation of normal butylene also contained in the crude butadiene stream from the Southern California Gas Co. plant operations. Disposition of the product was by pipe line to the nearby copolymer plants operated by Goodyear Synthetic Rubber Corp. and United States Rubber Co.

Houston.—Operation of this plant was by Sinclair Rubber, Inc., a wholly owned subsidiary of Sinclair Refining Co. Feed stock for the plant was normal butylene in the form of a mixed stream of hydrocarbons, received by pipe line from various refineries in the Houston area. Catalytic dehydrogenation was employed to convert butylene to butadiene and purification was by the furfural process. Shipment of product was made by pipe line to the adjacent Goodyear Synthetic Rubber Corp. copolymer plant.

Baton Rouge.—This standby plant was operated by Standard Oil Co. of New Jersey, now Esso Standard Oil Co. Feed stock, normal butylene, was supplied by the operator from its adjacent refinery in the form of a mixed stream of hydrocarbons. The normal butylene was catalytic dehydrogenated to butadiene and purified by the copper ammonium acetate process. Disposition of the product was via pipe line to the adjacent copolymer plant operated by Copolymer Corp.

El Segundo, Calif.—Standard Oil Co. of California, as agent for Rubber Reserve, operated this 18,000-short-ton per year plant. Feed stock for the plant's operation was delivered by pipe line from the operator's adjacent refinery. The feed stock, butane, was processed to butadiene by the Houdry process. Purification of the butadiene product was carried out in a vapor-phase copper ammonium acetate unit. Shipment of the product, to two copolymer plants in the area, was by tank truck.

Surplus Plants

Los Angeles.—This plant, operated by Southern California Gas Co. as agent for Rubber Reserve, supplied crude butadiene to another plant in the area operated by a Shell Oil Co. affiliate. Feed material for the plant, petroleum naphtha, was obtained from nearby refineries via pipe line. Processing of the naphtha was carried out by thermal cracking. The plant was not equipped with purification facilities. Shipment of the crude butadiene and its subsequent purification were made as outlined under Shell's Los Angeles plant operations. Late reports show this plant has not been sold.

Toledo.—Rated at 15,000 short tons per year, this plant was operated by Sun Oil Co. for the account of Rubber Reserve. The plant produced butadiene by processing butane in a Houdry unit. Purification was with a vapor-phase copper ammonium acetate unit. According to late information this plant has not been sold.

Sale of Plants

Ingleside, Tex.—Operated by Humble Oil & Refining Co. for the account of Rubber Reserve, this plant containing a variety of processing equipment, storage tanks, and other facilities was sold to Sampson Machine Supply Co. for $60,000.

El Dorado, Ark.—This plant operated without purification equipment to produce crude butadiene by thermally cracking naphtha in a T.V.P. unit. Purchase was by Lion Oil Co., the plant's wartime operator. Sales price was $68,000. Auxiliary equipment in the plant was owned by Lion Oil Co.

Baton Rouge.—This plant, government and privately owned, was designed for a capacity of 10,300 short tons yearly. Sale was to Esso Standard Oil Co. Processing equipment for converting naphtha to butadiene by cracking was privately owned. Government-owned items included a compressor plant, storage sphere, and miscellaneous tanks. Sale price was $325,000.

Corpus Christi, Tex.—Sales price on this plant was $150,000; purchaser—Taylor Refining Co. The plant was operated to produce crude butadiene by processing petroleum naphtha in a T.V.P. unit. Government-owned equipment included everything in the plant with the exception of a cooling tower and a naphtha-preheating furnace.

You can Count on us for:

- TRAINED MEN
- PERSONAL SUPERVISION
- ECONOMICAL MAINTENANCE
- TANK CONSTRUCTION

Yes sir, Sapulpa Tank Company has the answer to tank construction! Their "on-the-job" trained crews are ready, willing and able to meet your storage tank requirements. They are in the field—on the job—available with expert service.

Sure, we have close personal supervision on each job. Our foremen are experienced in tank maintenance, construction, and field fabrication "from the ground up". Each foreman, with years of experience plus the knack of handling men, insures quality workmanship.

Proper tank maintenance is our specialty. Whether it be the addition of appurtenances, repairing, rebuilding, or dismantling, our experienced crews are at your service over a wide area.

Contact Sapulpa Tank Company now and let a representative aid you with your tank requirements.

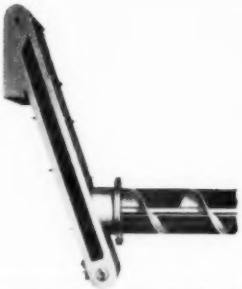
SAPULPA TANK COMPANY, Inc.

TANK CONTRACTORS

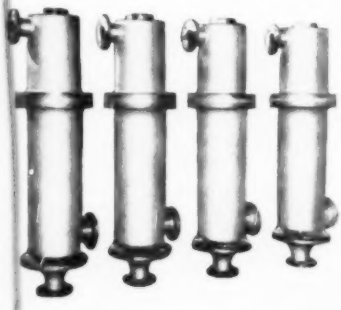
SAPULPA, OKLAHOMA **HOUSTON, TEXAS**

Pipe Fittings — Ampco pipe fittings are available in all sizes . . . ells, tees, crosses, reducing fittings and flanges . . . forged, wrought, fabricated or cast — with flanged, welding or screwed ends . . . schedule 10 through schedule 160.

Process Pipe . . . Prefabricated Ampco alloys selected for resistance to corrosive action of waste liquors. Prefabricated at Milwaukee from centrifugally cast sections, including flanges. Ampco pipe is also available in extruded seamless IPS up to 4" and in larger diameters welded automatically from Grade 8 plate.

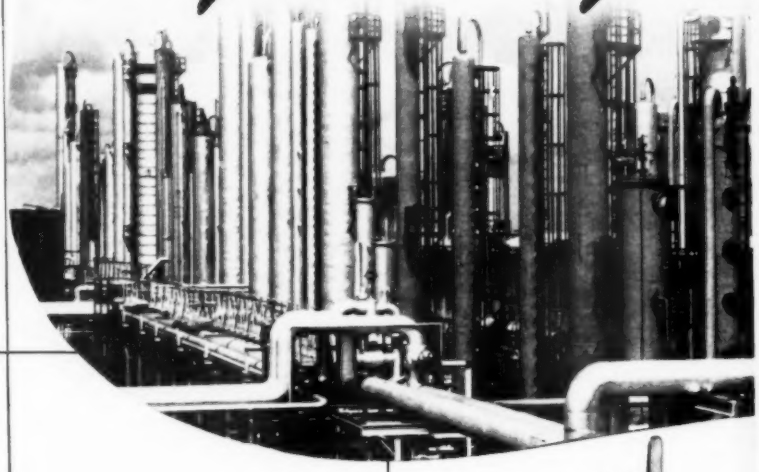


Conveyors . . . Sulphuric Acid Service — Ampco alloys selected for top resistance to erosion, corrosion and abrasion for conveyors handling bulk materials saturated with 10% H_2SO_4 at 210° F. Entire assembly — flights, troughs, shafts, buckets, chain, bearings, etc.—fabricated from Ampco alloys with matching Ampco-Trode electrodes.

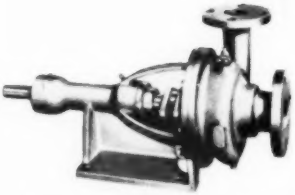


Barometric Condensers and Jet Ejectors — Ampco alloys selected for high strength, corrosion resistance and ability to withstand high-velocity impingement. Sand-cast venturi welded with Ampco-Trode to centrifugally cast body.

Ampco Alloys



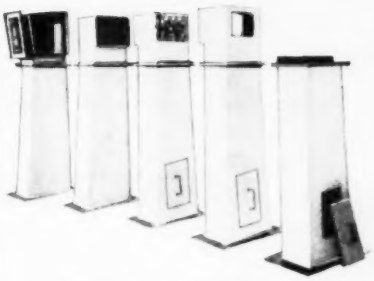
Heat Exchangers — Shown above are typical Ampco fabricated exchanger heads. Complete exchangers including tube sheets, tubing, heads and shells made from corrosion-resistant Ampco alloys are available through the fabricator of your choice.



Ampco Centrifugal Pumps — Here — for the first time in pump manufacturing history — is a "production-built" and "production-priced" pump to handle acids, salts, alkalies, and other corrosive agents hitherto requiring specially built pumps. The Ampco single stage, single suction centrifugal pump offers long life, high efficiency and low maintenance costs through the combination of correct design and properly selected materials.

Corrosion-Resistant Ampco Plug Valves — Made of properly mated Ampco alloys to combine operating efficiency with extremely long life—under the most severe conditions of corrosion, erosion, cavitation, and abrasion. No pockets to trap corrosive liquid. Available from ½ inch up to any desired pressure, in straight-through (2-way) or 3-way, lubricated or non-lubricated types.

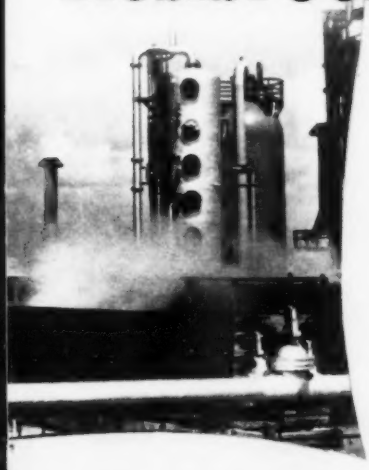
Fractionating Tower...Acetic Acid — Ampco alloys selected for resistance to corrosion by acetic and formic acids . . . and for maximum retention of physicals at temperatures up to 500° F. Fabricated of corrosion-resistant Ampco alloys throughout . . . deep-drawn sheet, plate, extruded tubing, centrifugal castings, etc. . . . welded with Ampco-Trode 160 electrodes.



Chutes . . . Potash Production — Ampco alloys selected to resist the severe erosive and corrosive effects of the mixture being carried. Fabricated of ¼" thick corrosion-resistant Ampco 8 plate welded with Ampco-Trode 160 electrodes. No pre-heating or post-heating was required. The weld joints match the parent-metal in chemical and physical properties.

AMPCO®

Resist Corrosion, Reduce Costs



. . . with this unique combination of money-saving properties:

1. High resistance to corrosion
2. High tensile strength
3. High physicals at extreme temperatures
4. High weight to strength ratio
5. High impact and fatigue values
6. High wear-resistance — to erosion — corrosion, cavitation, etc.
7. High compressive strength
8. High modulus of elasticity

The long service life of Ampco Bronze Alloys — at a moderate initial cost — offers unusual savings to both designers and plant engineers.

Reduced material failures mean (a) minimum down-time (b) less production loss and (c) lower maintenance costs.

Increase efficiency of design and operation . . . specify Ampco Bronze alloys for handling corrosive and erosive media. Write today for recommendation and complete information.

Ampco aluminum bronzes are available in a number of grades to meet your exact requirements in any form you need: rolled sheet or plate, sand or centrifugal castings, forgings or extrusions . . . pipe and fittings. Also, Ampco's arc-welding electrodes, corrosion-resistant centrifugal pumps and plug valves.

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U. S. Refineries Have Crude-Oil Input Capacity of 6.75 Million Barrels

by R. B. Tuttle
Associate Editor

RETURNS on The Oil and Gas Journal's 1950 survey of refineries in North America show that crude-oil input capacity of operating and shutdown plants in the United States is nearly 6.75 million barrels daily. Included in this total are 48 nonoperating refineries rated at 100 bbl. per day and above not definitely scheduled for immediate dismantling. Capacity rating on this group is just above 200,000 bbl. daily. The 346 operating plants in the United States have a total capacity in excess of 6.5 million barrels per day. The refineries rated at less than 100 bbl. per day are not included in this operating plant total.

Catalytic cracking units are now incorporated into the processing layout of 87 operating plants. Total capacity rating of these units on an input basis, including one installation operated jointly by three different refineries, is above 1.6 million barrels daily. A distribution of cat cracking capacity by states shows Texas leading with 22.75 per cent of the nation's total. California is second with 11.0 per cent, and Louisiana is third with 10.5 per cent.

Thermal cracking capacity located in 203 of the nation's operating refineries accounts for 56.5 per cent of all cracking capacity. Of the refineries operating thermal cracking processes, 78 are also equipped with catalytic cracking facilities. The remainder, 125 refineries, operate thermal processes only. Equipment for catalytic cracking only is installed in nine of the currently operating refineries.

Alkylation, Polymerization Capacity

Ten per cent of the country's operating plants are equipped with alkylation processes. The combined production capacity of this equipment, in round figures, is 115,000 bbl. of alkylate daily. A state-by-state breakdown shows Texas first with 35,000 bbl. per day of alkylate production. California has production capacity for approximately 29,000 bbl. daily. Third is Louisiana with 18,500 bbl. of daily production capacity. The average size of alkylation units operating in these three states is about 4,500 bbl. daily.

Equipment for polymerization operations is installed currently in 26 per cent of the United States operating refineries. Productive capacity of these units totals 58,000 bbl. plus per day. A distribution by states shows Texas to be first with more than 15,000 bbl. daily polymer production capacity. New Jersey is second, 6,200 bbl. per day, and California third with 5,400 bbl. daily.

Capacity Increase Since 1935

Crude-oil capacity of all United States refineries has increased approximately 172 per cent during the past 15 years while the number of refineries has decreased about 70 per cent. During the same period cracking capacity input has stepped up by nearly 180 per cent. Table 1 shows the increases in plant capacity from 1935.

For any single area Texas-Louisiana Gulf Coast has shown the greatest gain in the 15-year period. Crude-oil charging capacity for the operating refineries in this area was 756,000 bbl. daily in 1935. Today capacity of the plants in the area is 1,978,000 bbl. daily. The number of plants operating in the Gulf Coast area 15 years ago was two fewer than today's figure.

Cracking capacity in the Gulf Coast area has grown from 473,000 to 1,014,500 bbl. daily in the 1935-50 interval. Today there are 16 catalytic cracking units having a combined capacity of 478,600 bbl. per day in the area.

Rating on catalytic cracking equipment in the East Coast area totals 240,500 bbl. per day. This capacity is accounted for in six refineries. The largest single installation within the area has a total feed capacity of 85,000 bbl. daily.

Catalytic cracking equipment in California is installed in five refineries. Total capacity rating on these operations is currently 130,500 bbl. per day, total feed basis.

In the area comprised of Ohio, Indiana, Illinois, Missouri, Michigan, Arkansas, Oklahoma, Kansas, and North Texas catalytic cracking units are installed in 31 refineries. Capacity rating on total input to these operations is approximately 401,000 bbl. daily. A substantial portion of the capacity for this area is located in refineries within the Great Lakes region.

TABLE 1—NUMBER OF OPERATING REFINERIES AND THEIR CAPACITIES UNITED STATES—1935-1950

Year	Number	Input capacities, bbl. per day	
		Crude oil	Cracking*
1935	495	3,815,370	2,094,270
1940	448	4,430,975	2,201,300
1945	401	5,192,700	2,856,130
1949	380	6,515,505	3,752,390
1950	†346	6,540,265	3,707,905

*Including thermal and catalytic processes, cracking, reforming, etc., charge basis. †Exclusive of refineries rated at less than 100 bbl. daily crude oil capacity.

TABLE 2—POLYMERIZATION AND ALKYLATION PRODUCTION CAPACITY BY STATES

State—	Polymerization—		Alkylation—	
	No. units	Production capacity*	No. units	Production capacity*
Arkansas	1	400		
California	6	5,390	6	28,950
Colorado	2	450		
Illinois	6	4,250	4	13,050
Indiana	4	4,500	3	7,150
Kansas	7	2,750	2	1,400
Kentucky	3	1,675		
Louisiana	3	1,450	4	18,500
Massachusetts	1	500		
Michigan	3	1,145		
Missouri	1	850		
Montana	3	520		
New Jersey	3	6,200	1	500
Ohio	6	5,250	2	2,300
Oklahoma	10	3,835		
Pennsylvania	5	2,380	1	2,400
Texas	14	15,260	8	35,000
Utah			1	3,800
West Virginia	2	210		
Wyoming	5	1,200	1	1,700
Total	85	58,235	33	114,750

*Barrels per day basis.

It was 1912—and the Irving Berlin song, "When the Midnight Choo-Choo Leaves for Alabam" was the hit of the music halls—when we introduced "Flexitallic", the *original* Spiral-Wound Gasket, and opened to Industry new fields of opportunity in the confining of fluids at high pressures and high temperatures.

WHAT DO YOUR GASKETS COST . . . in place on the job?

Practically speaking, a gasket is a gasket only when it is working as a gasket—*in place on the job*—and its value is determined by how long it continues to maintain a safe seal.

It costs a lot of money when a gasket fails. The cost of the gasket is generally of minor importance. The real cost is measured in terms of operating loss, danger to personnel and labor costs for replacement.

That is why the great oil refineries, chemical industries, power plants, shipyards, ship operating companies and others, seriously concerned with high pressures and high temperatures, specify Flexitallic Gaskets . . . They know *from experience* that, in-place-on-the-job, Flexitallic is the most economical buy.

Flexitallic Gaskets are Spiral-Wound of preformed, spring-like metal, alternating, ply for ply with either metallic, or non-metallic filler. The V-shaped, interlocking crimp, imparted during the preforming process, gives Flexitallic Gaskets a flexibility which provides the necessary high resiliency for self adjustment to changes in operating conditions and bonding pressures.

If safe sealing is of serious concern to you, and you would like additional proof of the superior performance of Flexitallic Gaskets, write us today. Give us these facts on your sealing requirements: (1) Fluid to be confined; (2) Type of flange and dimensions; (3) Operating pressures and temperatures; (4) Bolting data.

In return, we will send you a genuine Flexitallic Spiral-Wound Gasket with our compliments. Examine it—test it severely—in your laboratory or on a job. The results will demonstrate to you why most industries vitally concerned with safe seals of high pressures and temperatures are standardized on Flexitallic Gaskets.

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Eighth and Bailey Streets, Camden 2, N. J., U.S.A.

The name "Flexitallic" is the registered trade mark identifying the *original* (patented) Spiral-Wound Gasket. Now—for your protection and ours—this trade mark FLEXITALLIC is stamped into the outer ply of every *genuine* Flexitallic Gasket. Your guarantee of quality.

346 Operating Plants, 48 Idle, Survey Shows

EXPLANATION OF ABBREVIATIONS USED IN TABLES

Refinery type:
- (S)—Crude-oil distillation
- (C)—Thermal and/or catalytic cracking
- (A)—Asphalt
- (L)—Lubricating oils
- (W)—Wax
- (Comp.)—Complete refinery with S-C-L facilities plus A and/or W.

Catalytic cracking, type unit:
- (F)—Fluid
- (T)—Thermofor
- (H)—Houdry
- (Hf)—Houdriflow
- (Pf)—Platforming
- (C)—Cycloversion
- (S)—Suspensoid

Summary of Refineries in the United States

THEIR DISTRIBUTION AND CAPACITY*

	Operating plants			Idle plants			All plants		
	No. plants	Crude-oil cap.	Cracking cap.†	No. plants	Crude-oil cap.	Cracking cap.†	No. plants	Crude-oil cap.	Cracking cap.†
Alabama	2	11,500					2	11,500	
Arkansas	6	60,200	31,300	1	2,500		7	62,700	31,300
California	50	1,039,200	632,950	6	25,700	15,000	56	1,064,900	647,950
Colorado	7	22,800	11,500				7	22,800	11,500
Delaware	1	3,500					1	3,500	
Georgia	1	5,500					1	5,500	
Idaho	1	4,500	600				1	4,500	600
Illinois	13	384,100	263,400	4	13,500	3,650	17	397,600	267,050
Indiana	9	344,300	218,300				9	344,300	218,300
Kansas	15	213,400	141,040	3	26,000	15,000	18	239,400	156,040
Kentucky	7	77,500	53,600	1	1,500		8	79,000	53,600
Louisiana	14	466,000	277,650	2	10,000		16	476,000	277,650
Maryland	3	66,500	36,000				3	66,500	36,000
Massachusetts	2	52,000	32,000				2	52,000	32,000
Michigan	16	111,400	51,600	1	3,500	1,500	17	114,900	53,100
Minnesota	2	7,500					2	7,500	
Mississippi	2	8,000	2,000				2	8,000	2,000
Missouri	1	37,800	38,500				1	37,800	38,500
Montana	13	62,900	29,100	8	6,800		21	69,700	29,100
Nebraska	5	7,400	750	1	800		6	8,200	750
New Jersey	7	395,000	235,100				7	395,000	235,100
New Mexico	8	16,250	6,250				8	16,250	6,250
New York	6	94,000	42,900				6	94,000	42,900
Ohio	13	283,100	271,500				13	283,100	271,500
Oklahoma	22	273,800	181,400	3	17,000	14,000	25	290,800	195,400
Oregon	2	4,200					2	4,200	
Pennsylvania	19	505,400	253,815				19	505,400	253,815
Rhode Island	3	13,000	1,400				3	13,000	1,400
South Carolina	1	6,500					1	6,500	
South Dakota	3	405					3	405	
Tennessee	2	5,000	1,200				2	5,000	1,200
Texas	65	1,789,050	1,001,250	14	89,650	17,750	79	1,878,700	1,019,000
Utah	4	56,200	30,300				4	56,200	30,300
Washington	1	5,500	1,000				1	5,500	1,000
West Virginia	4	15,500	8,550				4	15,500	8,550
Wisconsin	1	5,500					1	5,500	
Wyoming	15	85,860	52,950	4	8,300	1,500	19	94,160	54,450
Total	346	6,540,265	3,707,905	48	205,250	68,400	394	6,745,515	3,976,305

*Capacities in barrels per day. †Includes thermal and catalytic cracking, vis-breaking, and reforming processes.

NORTH AMERICAN OPERATING REFINERIES

Where They Are, Their Capacities, And Types of Processes

Compiled by The Oil and Gas Journal Statistical Department

ALABAMA

Company and refinery location—	Refinery type	Crude-oil charge— cap. bbl. per day	Thermal cracking— cap. bbl. per day	Catalytic cracking Capacity bbl. per day	Catalytic cracking Type of unit	Railroads serving refinery
American Bitumuls Co.:						
Mobile	S	[1]8,000				
Hunt Oil Co.:						
Tuscaloosa	S-A	3,500				
Total		11,500				

1. Capacity is that reported by former operator, Coastal Petroleum Corp.

ARKANSAS

Berry Asphalt Co.:						
Stephens	S-A	2,000				Reader Railroad
Waterloo	S-L-A	1,200				St. L. Southwestern
Henry H. Cross Co.:						
Smackover	S-L-A	6,000				Mo. P.
Lion Oil Co.:						
El Dorado	Comp.	22,000		[1]6,000	T	C.R.I.&P.; El Dorado & Wesson; Mo. P.; Rock Island
MacMillan Petroleum Co.:						
Norphlet	S-L	4,000				Mo. P.
Pan-Am. Southern Corp.:						
El Dorado	S-C	25,000	[2]17,300	8,000	F	Mo. P.
Total		60,200	17,300	14,000		

1. Polymerization production capacity 400 bbl. daily. 2. Includes 9,300-bbl. daily coking unit under construction.

CALIFORNIA

Aromalene, Inc.:						
Long Beach	S	1,800				None
Bell Petroleum Co.:						
Casmalia	S-C	3,500	200			S.P.
Ben Hur Refining Corp.:						
Long Beach	S	4,700				None
Calstate Refining Co.:						
Long Beach	C		2,000			None
Caminol Co., Ltd.:						
Hanford	S-C	3,100	600			
Century Oil Co.:						
Signal Hill	S	5,000				None
Douglas Oil Co. of California:						
Bakersfield	S-C	6,500	3,500			A.T.&S.F.; S.P.
Paramount	S-A	4,000				Pacific Electric
Edgington Oil Refinery:						
Long Beach	S-L-A	5,000				
Envoy Petroleum Co.:						
Long Beach	S-A	3,000				
Five C Refining Co.:						
Santa Maria	S-A	3,500				Santa Maria Valley
Fletcher Oil Co.:						
Wilmington	C		[1]3,600			None
General Petroleum Corp.:						
Lebec	S	23,000				None
Torrance	S-C	100,000	[2]43,500	40,000	T	A.T.&S.F.
Vernon	S-A	4,000				U.P.; S.P.
Golden Bear Oil Co.:						
Oildale	S-L-A	3,000				A.T.&S.F.; S.P.
Hancock Oil Co. of California:						
Long Beach	S-C	12,500	[3]7,000			U.P.
MacMillan Petroleum Corp.:						
Signal Hill	S	7,000				Pacific Electric
McCallel Refining Co.:						
Huntington Beach	S	5,000				None
Mohawk Petroleum Corp.						
Bakersfield	S-C	11,000	[3]3,800			A.T.&S.F.
Newhall Refining Co.:						
Newhall	S-A	3,000				S.P.
Norwalk Co.:						
Maricopa	S	10,000				Sunset
Olympic Refining Co.:						
Long Beach	S	5,500				S.P.; Pacific Electric
Oxnard Oil & Refining Co.:						
Oxnard	S-A	2,500				S.P.
Pacific States Oil Co.:						
Wilmington	S	25,000				Harbor Belt Line
Palomar Oil & Refining Corp.:						
Bakersfield	S-L-A	1,300				
Paraffin Companies, Inc.:						
Emeryville	S-A	1,500				
Petrol Corp.:						
Los Angeles	S-A	6,000				
Richfield Oil Corp.:						
Vindale	S-C	10,000	4,500			S.P.
Watson	S-C	91,000	[4]45,000	23,000	T	Pacific Electric

CALIFORNIA (Continued)

Company and refinery location—	Refinery type	Crude-oil charge— cap. bbl. per day	Thermal cracking— cap. bbl. per day	Catalytic cracking Capacity bbl. per day	Catalytic cracking Type of unit	Railroads serving refinery
Rothschild Oil Co.:						
Santa Fe Springs	S-C-A	13,000	5,000			A.T.&S.F.
Seaside Oil Co.:						
Ventura	S-A	4,500				U.P.
Shell Oil Co.:						
Martinez	Comp.	45,000	26,000			S.P.
Wilmington	S-C	52,000	[9]37,000	15,000	F	A.T.&S.F.; Pacific Electric
Socal Oil & Refining Co.:						
Huntington Beach	S-C	2,500	1,450			Pacific Electric
Standard Oil Co. of California:						
Bakersfield	S-C	17,000	8,200			S.P.
El Segundo	S-C	117,000	[6]69,000			S.P.
Richmond	Comp.	138,000	[5]56,000	32,500	T	S.P.; A.T.&S.F.
Sunland Refining Corp.:						
Bakersfield	S	3,000				A.T.&S.F.
Sunray Oil Corp.:						
Santa Maria	S-A	7,000	3,000			Santa Maria Valley
Sunset Oil Co.:						
Los Angeles	S	8,500				None
Texas Co.:						
Los Angeles	S-C	50,000	10,000	20,000	F	A.T.&S.F.; S.P.
Tide Water Associated Oil Co.:						
Associated	Comp.	[8]85,000	[12]34,100	20,000	F	A.T.&S.F.; S.P.
Wilmington	S-C	14,000	[11]8,200			S.P.
Triangle Oil & Refining Co.:						
Venice	S	2,500				
Union Oil Co. of California:						
Bakersfield	S-A	5,800				A.T.&S.F.; S.P.
Oleum	Comp.	23,000	[14]42,000			S.P.
Wilmington	S-C-A	66,000	[13]27,500	27,500	T	Harbor Belt Line
Western Asphalt & Refining Co.:						
Wilmington	S-A	2,000				Santa Maria Valley
Wilshire Oil Co., Inc.:						
Norwalk	S-C	22,000	[14]14,000			A.T.&S.F.
Total		1,039,200	454,950	178,000		

1. Polymerization production capacity, 100 bbl. daily.
2. Vis-breaking, 16,000 bbl. daily; gas-oil reforming 5,000 bbl. per day and coking 22,500 bbl. daily.
3. Capacity on fresh feed basis; cracking 2,000 and vis-breaking 5,000 bbl. daily.
4. Polymerization production capacity 50 bbl. daily.
5. Polymerization production capacity 500 bbl. daily. Alkylation production, 4,000 bbl. daily.
6. Alkylation production capacity 5,000 bbl. daily.
7. Alkylation production capacity 4,250 bbl. daily.
8. Alkylation production capacity 2,700 bbl. daily.
9. Includes crude oil charged to vis-breaking and feed-preparation units.
10. Thermal cracking capacity includes vis-breaking operations. Refinery is equipped with alkylation (5,000 bbl. daily production) and polymerization units; polymerization 540 bbl. per day production capacity, not operating currently.
11. Vis-breaking operation.
12. Includes coking, 18,600 bbl. per day, and crude cracking 23,400 bbl. per day. Catalytic hydroformer 6,800 bbl. daily production capacity, and polymerization unit, 200 bbl. per day production, are not operating currently.
13. Smaller of two alkylation units 3,000 and 500-bbl. daily production capacity, is not operating currently. Production capacity on gas-reversion operations 5,700 bbl. daily. Crude-oil charging capacity is divided, 56,000 bbl. per day to combination unit and 10,000 bbl. per day to topping unit.
14. Polymerization and 4,000 bbl. per day reforming units not operating.

COLORADO

Bay Petroleum Corp.:						
Denver	S-C	5,000	[3]3,200			C.B.&Q.; U.P.
Continental Oil Co.:						
Denver	S-C	7,500	[2]1,800	[3]3,000	T	U.P.
Empire Petroleum Co.:						
Denver	S-A	2,500				C.B.&Q.
Gordon Refining Co.:						
Fort Morgan	S	200				
Oriental Refining Co.:						
Alamosa	S-C	1,100	900			
Denver	S-C	5,000	2,000			
Skelly Oil Co.:						
Denver	S-C	1,500	600			U.P.
Total		22,800	8,500	3,000		

1. Thermal cracking capacity 2,200 bbl. per day; reforming capacity 1,000 bbl. daily. Polymerization 75 bbl. per day production capacity.
2. Polymerization production capacity 375 bbl. daily.
3. Fresh feed basis.

DELAWARE

Texas Co.:						
Claymont	S-A	3,500				Pennsylvania

GEORGIA

Mexican Petroleum Corp. of Georgia:						
Savannah	S-A	5,500				Savannah & Atlanta

IDAHO

Phillips Petroleum Co.:						
Pocatello	S-C	4,500	[1]600			U.P.

1. Gasoline production from thermal cracking operations.

Important FACTS ABOUT pH for Profit-Minded Refinery Engineers

WHETHER YOU ARE building a new plant or modernizing present equipment, one of the most important advancements you can make is the installation of **BECKMAN pH CONTROL**. Through the magic of accurate pH control you can make *many* vital savings... savings that will quickly pay for the installation and will *continue* paying big dividends throughout the years. For example, some of the many benefits resulting from Beckman pH Control include...

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- Neutralizing acids in stills to assure a uniform acid-free product.
- Maintaining constant cooling water check for immediate detection of hidden leaks in lines and equipment.
- Treating process and boiler feed water to assure soft, neutral water, greater freedom from liming and boiler maintenance, substantial savings in chemicals.
- Reliable control of waste disposal with better neutralization of acid and caustic effluents . . . at lower chemical costs.

...*and many other important savings in modern refinery and laboratory operations.*

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Beckman pH equipment is completely electrometric, eliminating the mess and inaccuracies of colorimetric methods. Simply press a button and the exact pH of any process is instantly shown on a large easily-read dial. *It is the simplest of all pH methods!*

The accuracy of Beckman pH readings is completely unaffected by human errors in color judgment, by turbidity, oxidizing or reducing agents, by suspended materials, colored process solutions or other variables that affect outmoded colorimetric methods. *Beckman pH readings are universally accurate and dependable!*

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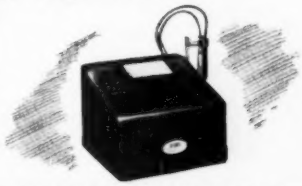
COMPLETELY AUTOMATIC! The Beckman Model R instrument operates directly from standard 110 v. A.C. lines to provide completely automatic pH indication. Also provides for completely automatic pH recording and automatic process control. Can be installed to give accurate pH readings from various stations in plant through one instrument. *This is the pH unit being installed by today's most modern plants, large and small.*



PORTABLE A.C. OPERATION! The Beckman Model H instrument can be quickly moved from one part of the plant to another and plugs directly into standard 110 v. 50/60 cycle A.C. current. Compact, convenient and extremely simple to operate, the Model H gives instant pH readings on an easily-read dial. It is widely used both for manual pH control of small plants and as an auxiliary instrument on completely automatic pH installations.

COMPLETELY SELF-CONTAINED! The Beckman Model M is the ideal pH instrument where *complete* portability is desired. Operating from its own self-contained, long-life power supply, the Model M can be used anywhere in the plant or field, whether convenient to power lines or not. Features the same accuracy, simplicity and operating speed as the Model H, and is also widely used both for manual pH control of small plants and as auxiliary equipment on large automatic installations.

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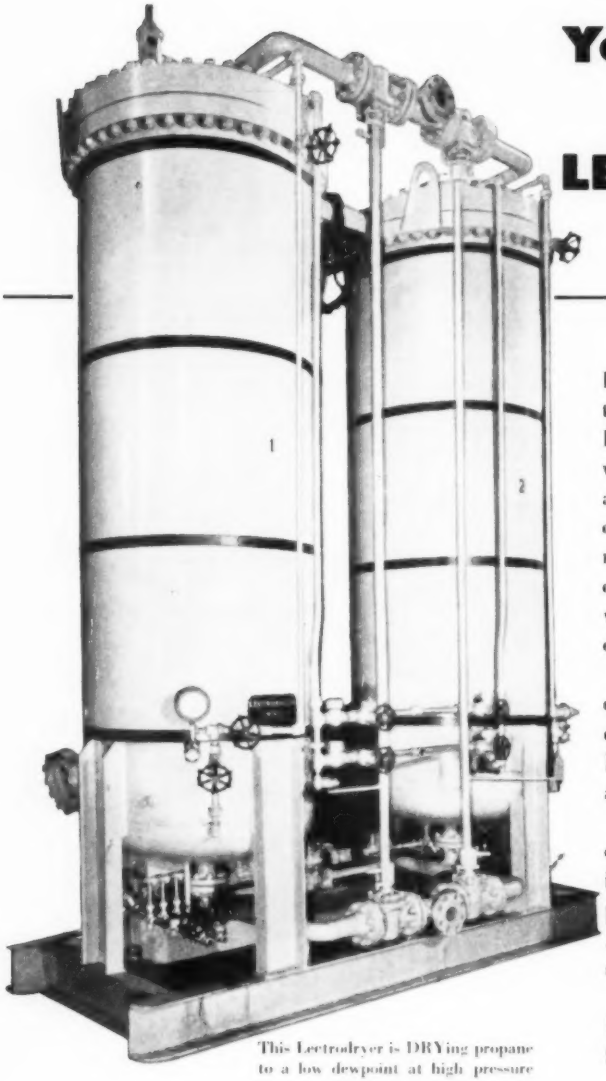

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ILLINOIS

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Arrow Petroleum Co.:						
Centralia	S-C	4,000	(1)			Missouri & Illinois
Calumet Refining Co.:						
Burnham	S-L	1,200				B.&O.C.T.
Cross Co., Henry H.:						
Colmar	S	1,000				C.B.&Q.
Globe Oil & Refining Co.:						
Lemont	S-C-A	37,000	[2]21,500	6,000	F	G.M.&O.; A.T.&S.F.
Great Lakes Ref. Div. of Petco Corp.:						
Blue Island	S-C	10,000	5,000	5,000	HF	B.&O.C.T.; I.H.B.
Ohio Oil Co.:						
Robinson	S-C-A	25,000	[3]9,000	12,400	F	I.C.; C.C.C.&St. L.
Red River Refining Co.:						
Chicago	S-L	1,100				B.&O.C.T.
Shell Oil Co.:						
Wood River	Comp.	115,000	[4]30,000	38,000	F	Illinois Terminal; C.C.C.& St. L.; G.M.&O.
Socony-Vacuum Oil Co., Inc.:						
East St. Louis	S-C	30,000	[5]4,500	18,000	H; T	
Standard Oil Co. (Ind.):						
Wood River	Comp.	42,800	[6]17,000	13,500	F	Illinois Terminal; G.M.&O.; N.Y.C.
Texas Co.:						
Lawrenceville	Comp.	27,000	[7]15,000			B.&O.; N.Y.C.
Lockport	S-C-A	60,000	[8]25,000	20,000	F	A.T.&S.F.; G.M.&O.
Wood River Oil & Refining Co.:						
Hartford	S-C-A	30,000	[9][10]16,000	7,500	F	Illinois Terminal; N.Y.C.
Total		384,100	143,000	120,400		

1. Catalytic reforming capacity not reported.
2. Includes 6,500 bbl. daily reforming capacity. Polymerization production capacity 900 bbl. daily.
3. Under construction.
4. Polymerization production capacity 1,000 bbl. per day.
5. Includes 16,000 bbl. daily vis-breaking capacity. Alkylation production capacity 5,000 bbl. daily. Polymerization production capacity 850 bbl. per day.
6. Includes 2,700 bbl. per day vis-breaking capacity. Alkylation production 1,500 bbl. daily.
7. Includes reforming capacity. Alkylation production capacity 4,150 bbl. per day. Polymerization production capacity 50 bbl. daily.
8. Polymerization production capacity 500 bbl. daily.
9. Alkylation production capacity 2,400 bbl. daily. Polymerization production capacity 500 bbl. daily.
10. Includes 10,000 bbl. per day cat. reforming capacity. Polymerization production capacity 500 bbl. daily.

INDIANA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Cities Service Oil Co. (Del.):						
East Chicago	S-C	35,000	[1]20,000	14,700	F	B.&O.C.T.; Pennsylvania
Indiana Farm Bureau Co-op Assn., Inc.:						
Mount Vernon	S-C	8,000	[2]3,500	4,000	F	L.&N.; C.&E.I.
Johnson Oil Supply Corp.:						
Gary	S	2,500				
R. J. Oil & Refining Co., Inc.:						
Princeton	S	1,200				C.&E.I.
Rock Island Refining Corp.:						
Indianapolis	S-C	10,000		5,000	F	N.Y.C.
Sinclair Refining Co.:						
East Chicago	Comp.	85,000	[3]32,000	30,000	F	Pennsylvania; B.&O.C.T.
Socony-Vacuum Oil Co., Inc.:						
East Chicago	S-C	25,000	[4]9,500			
Standard Oil Co. (Ind.):						
Whiting	Comp.	175,800	[5]49,600	50,000	F	B.&O.C.T.; E.J.&E.; I.H.B.; N.Y.C.; Pennsylvania
Troy Refining Co.:						
Troy	S	1,800				Southern
Total		344,300	114,600	103,700		

1. Includes delayed coking capacity, 17,500 bbl. per day. Alkylation production capacity 1,900 bbl. daily.
2. Polymerization production capacity 300 bbl. per day.
3. Polymerization production capacity 250 bbl. per day.
4. Includes 8,000 bbl. daily reforming capacity. Alkylation production capacity 750 bbl. daily. Polymerization production capacity 2,450 bbl. per day.
5. Includes 2,700-bbl.-per-day reforming capacity.
6. Includes 11,600-bbl.-per-day vis-breaking capacity and 8,500-bbl.-per-day hydroformer charge. Alkylation production capacity 4,500 bbl. daily. Polymerization production capacity 1,500 bbl. per day.

KANSAS

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Barco Oil Co.:						
Wichita	S-C	6,500	[1]7,200			Wichita Terminal Ry. Assn.
Bay Petroleum Corp.:						
McPherson	S-C	6,000	[2]4,600			A.T.&S.F.
Cooperative Refinery Association:						
Coffeyville	Comp.	19,000	5,700	5,500	F	M.K.&T.; A.T.&S.F.
Phillipsburg	S-C	4,200	[3]2,200			C.R.I.&P.
Derby Oil Co.:						
Wichita	S-C-A	10,000	[4]5,000			
El Dorado Refining Co.:						
El Dorado	S-C	8,500	8,000			Mo. P.; A.T.&S.F.
Kanotex Refining Co.:						
Arkansas City	S-C-A	8,500	[5]9,500			Mo. P.
Missouri Farmers Association:						
Chanute	S-C	1,800	1,000			A.T.&S.F.
National Co-op Refinery Association:						
McPherson	S-C	18,000	[6]13,500			Mo. P.; C.R.I.&P.
Phillips Oil Co.:						
Kansas City	Comp.	50,000	[7]14,000	(8)	F	U.P.; Mo. P.

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Propane Dewaxing
Duo-Sol Treating
Methyl-Ethyl-Ketone Treating
Phenol Treating
Furfural Treating
Sulfur-Dioxide Treating
Propane Deasphalting
Hypersorption
Wax Manufacture
Three-Stage Distillation
Fluid Catalytic Cracking
Cycloversion Catalytic Cracking
Suspensoid Catalytic Cracking
Perco Catalytic Reforming
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Catalytic Polymerization
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Carbon Moly Steel (½% Cr, ½% Mo)
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Croloy 1¼ (2% Cr, 1% Mo)
Croloy 2 (2¼% Cr, 1% Mo)
Croloy 2¼ (3% Cr, 1% Mo)
Croloy 3-M (5% Cr, ½% Mo)
Croloy 5 (5% Cr, ½% Mo, 1½% Si)
Croloy 5-Si (5% Cr, ½% Mo, ½% Ti)
Croloy 5-Ti (7% Cr, ½% Mo)
Croloy 7 (9% Cr, 1% Mo)
Croloy 9-M (18% Cr, 8% Ni)
Croloy 18-8-S (16% Cr, 13% Ni, 3% Mo)
Croloy 16-13-3 (25% Cr, 20% Ni)
Croloy 25-20
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KANSAS (Continued)

Company and refinery location—	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Shallow Water Refining Co.:						
Garden City	S-C-A	2,500	900			A.T.&S.F.
Skelly Oil Co.:						
El Dorado	S-C-A	35,000	[8]17,000	14,500	F	Mo. P.; A.T.&S.F.
Socony-Vacuum Oil Co., Inc.:						
Augusta	S-C-A	26,500	[10]8,940	9,000	H	
Standard Oil Co. (Ind.):						
Neodesha	S-C	10,400	[11]7,100			Mo. P. St. L.&S.F.
Vickers Petroleum Co., Inc.:						
Potwin	S-C	6,500	[6][7]7,400			Mo. P.
Total		213,400	112,040	29,000		

1. Includes 4,000 bbl. daily reforming capacity.
2. Includes 1,000-bbl.-per-day reforming capacity. Polymerization production capacity 100 bbl. daily.
3. Includes 1,500-bbl.-per-day reforming capacity. Polymerization production capacity 1,000 bbl. daily.
4. Polymerization production capacity 50 bbl. daily.
5. Polymerization production capacity 100 bbl. daily.
6. Includes 5,000-bbl.-per-day catalytic reforming capacity. Polymerization production capacity 250 bbl. daily.
7. Includes 1,500-bbl.-per-day thermal reforming capacity and 3,000-bbl.-per-day catalytic reforming capacity.
8. Production basis including thermal and catalytic cracking and polymerization operations.
9. Includes 5,000-bbl.-per-day reforming capacity. Polymerization production capacity 1,000 bbl. daily. Alkylation production 700 bbl. daily.
10. Includes 1,440 bbl. daily reforming capacity and 3,600-bbl.-per-day vis-breaking capacity. Alkylation production capacity 700 bbl. daily.
11. Includes 2,100 bbl. per day reforming capacity.
12. Includes 1,000-bbl.-per-day reforming and 3,200-bbl.-per-day vis-breaking capacity. Polymerization production 250 bbl. daily.

KENTUCKY

Company and refinery location—	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Aetna Oil Co.:						
Louisville	S-C	8,000	4,600			K.&I.T.
Ashland Oil & Refining Co.:						
Catlettsburg (1)	S-C-A	18,000	[3]9,500			C.&O.
Catlettsburg (2)	S-C	25,000		[2]18,500	T	C.&O.
Louisville Refining Co.:						
Louisville	S-C	6,500	[3]2,500			L.&N.; B.&O.; N.Y.C.; K.&I.T.; C.&O.; Southern
Somerset Refinery:						
Somerset	S	1,500				Southern
Standard Oil Co. (Ohio):						
Latonia	S-C-A	16,500	[4]18,500			L.&N.
Stoll Oil Refining Co.:						
Louisville	S-L-W	2,000				L.&N.
Total		77,500	35,100	18,500		

1. Includes 2,500-bbl.-per-day reforming capacity.
2. Polymerization production 1,200 bbl. daily of which 450 bbl. per day is now building.
3. Polymerization production 75 bbl. daily.
4. Includes 5,000-bbl.-per-day reforming capacity. Polymerization production 400 bbl. daily.

LOUISIANA

Company and refinery location—	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Bayou State Oil Corp.:						
Hosston	S-L-A	1,000				T.&P
Breaux Bridge Oil Refining Co., Inc.:						
Breaux Bridge	S-C	500	[1]1,150			T.&N.O.
Calumet Refining Co.:						
Princeton	S-L-A	700				L.&A.
Chalmette Petroleum Corp.:						
Chalmette	S-C	11,000	[3]6,500			New Orleans Terminal
Cit-Con Oil Corp.:						
Lake Charles	L-W	[2]				K.C.S.; S.P.
Cities Service Refining Corp.:						
Lake Charles	S-C	130,000	[4]10,000	[4]85,000	F	S.P.; K.C.S.
Clark's Refinery Div. of Petco Corp.:						
Marrero	S-C	5,000	3,000			T.&P.; M.P.T.
Continental Oil Co.:						
Westlake	S-C	11,000	[5]5,500			K.C.S.; S.P.; T.&N.O.
Esso Standard Oil Co.:						
Baton Rouge	Comp.	245,000	[6]55,000	85,000	F	I.C.; L.A.; N.O.T.&M.
Evangeline Refining Co., Inc.:						
Jennings	S-C	1,000				S.P.
Pan-Am Southern Corp.:						
Destrehan	S-L-A	8,000				I.C.
Shell Oil Co.:						
Norco	S-C-L	45,000	[7]23,300			L.C.; L.A.
Southern States Refining Co.:						
Eola	S	800				
Stanolind Oil & Gas Co.:						
Vivian	S-C	7,000	3,200			K.C.S.; L.A.
Total		466,000	107,650	170,000		

1. Under construction.
2. Polymerization production capacity 250 bbl. daily.
3. Processes stocks from outside sources to produce lubes and wax; plant capacity 6,000 bbl. daily.
4. Capacity on total charge basis. Alkylation production capacity 6,500 bbl. daily.
5. Includes 1,500-bbl.-per-day thermal reforming capacity. Alkylation production 765 bbl. daily. Polymerization production 600 bbl. daily.
6. Includes reforming and vis-breaking capacity. Alkylation production 10,000 bbl. daily. Polymerization production 4,000 bbl. daily.
7. Includes 3,300-bbl.-per-day reforming capacity. Alkylation production 1,250 bbl. daily. Polymerization production 600 bbl. daily.

SURVEY OF OPERATING REFINERIES

MARYLAND

Company and refinery location—	Refinery type	Crude-oil charge— cap. per per day	Thermal cracking— cap. per per day	Catalytic cracking Capacity bbl. per day	Catalytic cracking Type of unit	Railroads serving refinery
American Bitumuls Co.:						
Baltimore	S-A	6,000				B.&O.
Esso Standard Oil Co.:						
Baltimore	Comp.	54,000	[1]12,000	24,000	F	B.&O.; Canton; Pennsylvania
Pan American Refining Corp.:						
Baltimore	S-A	6,500				B.&O.; Pennsylvania
Total		66,500	12,000	24,000		

1. Includes reforming and vis-breaking capacity. Alkylation production 3,500 bbl. daily.

MASSACHUSETTS

Cities Service Oil Co. (Pa.):						
East Braintree	S-A	15,000				
Esso Standard Oil Co.:						
Everett	S-C-A	37,000	[1]32,000			N.Y.C.
Total		52,000	32,000			

1. Includes reforming and vis-breaking capacity. Polymerization production 500 bbl. daily.

MICHIGAN

Aurora Gasoline Co.:						
Detroit	S-C-A	16,000	[3]9,000	7,000	F	Wabash; Pennsylvania
Elsie	S	5,500				Ann Arbor
Bay Refining Co.:						
Bay City	S	10,500				D.&M.; C.&O.; N.Y.C.
Crystal Refining Co. of Carson City, Inc.:						
Carson City	S	6,200				G.T.W.
Lakeside Refining Co.:						
Kalamazoo	S	2,000				
Leonard Refineries, Inc.:						
Alma	S-C-A	8,500	[3]3,000	6,000	F	C.&O.
Marvel Refining Co.:						
Grand Rapids	S	2,000				C.&O.
Mid-West Refineries, Inc.:						
Alma	S-C	4,500	2,700			Ann Arbor; P.M.
Naph-Sol Refining Co.:						
Muskegon	S-C	5,000	2,500			C.&O.
Old Dutch Refining Co.:						
Muskegon	S-C	4,500	[4]1,200	2,000	Pf.	G.T.W.
Osceola Refining Co., Inc.:						
Reed City	S	2,000				C.&O.
Petroleum Specialties, Inc.:						
Flat Rock	S	3,500				
Producers Refining, Inc.:						
West Branch	S-A	3,500				N.Y.C.
Pure Oil Co.:						
Midland	S	4,700				C.&O.
Roosevelt Oil & Refining Corp.:						
Mount Pleasant	S-C	8,000		1,500	P	Ann Arbor
Socony-Vacuum Oil Co., Inc.:						
Trenton	S-C	25,000	7,700	9,000	H	
Total		111,400	26,100	25,500		

1. Reforming capacity 4,000 bbl. daily; vis-breaking capacity 5,000 bbl. daily. Polymerization production 1,000 bbl. daily.
2. Reforming capacity 1,800 bbl. daily; vis-breaking 1,200 bbl. daily. Polymerization 100 bbl. daily.
3. Includes 900-bbl. daily reforming capacity.
4. Polymerization production 45 bbl. daily.
5. Includes 4,100 bbl. daily reforming capacity.

MINNESOTA

Northwestern Refining Co.:						
New Brighton	S	5,000				
St. Paul Park	S-A	2,500				
Total		7,500	None	None		

MISSISSIPPI

Paluxy Asphalt Co.:						
Crupp	S-C-A	3,500	2,000			
Southland Oils, Inc.:						
Sandersville	S-A	4,500				
Total		8,000	2,000			

MISSOURI

Standard Oil Co. (Ind.):						
Sugar Creek	S-C-W-A	37,800	[1]18,500	20,000	F	A.T.&S.F.; K.C.S.

1. Includes reforming capacity. Polymerization production 850 bbl. daily.

MONTANA

A & O Construction Co.:						
Kalispell	S-A	1,000				G.N.
Big West Oil Co. of Montana:						
Kevin	S-C-A	2,000	[1]1,500			G.N.
Carter Oil Co.:						
Billings	S-C-A	20,000		10,000	F	C.B.&Q.; G.N.; N.P.
Cut Bank	S-C	4,000	800			G.N.
Continental Oil Co.:						
Billings	S-C	6,800		[3]3,300	F	N.P.
Eugene Hunt:						
Winnett	S	300				C.M.St.P.

MONTANA (Continued)

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl per day	Catalytic cracking—Type of unit	Railroads serving refinery
Farmers Union Central Exchange, Inc.:						
Laurel	S-C-A	10,000	6,000			C.B.&Q.; N.P.; G.N.
Hart Refineries:						
Missoula	S-A	700				C.M.&St.P.
North Star Refining Co.:						
Shelby	S	1,500				G.N.
Phillips Petroleum Co. (Operator):						
Great Falls	S-C	2,800	600			G.N.
Solar Oil & Refining Co.:						
Hardin	S	2,500				C.B.&Q.
Texas Co.:						
Sunburst	S-C	7,500	5,000			G.N.
Union Oil Co. of California:						
Cut Bank	S-C	3,800	1,900			G.N.
Total		62,900	15,800	13,300		

1. Includes 300 bbl. daily reforming capacity.
2. Polymerization production 360 bbl. daily.
3. Polymerization production 150 bbl. daily.
4. Production including polymer gasoline.
5. Polymerization production 70 bbl. daily.

NEBRASKA

Cooperative Refinery Association:						
Scotts Bluff	S-C	2,200	750			C.B.&Q.
Mid-States Refining Co.:						
Falls City	S	3,000				M.P.; C.B.&Q.
Petroleum Utilities Co., Inc.:						
Chadron	S	700				None
Porter Oil Co.:						
Sidney	S	300				None
Searle Petroleum Co.:						
Omaha	S	1,200				I.C.
Total		7,400	750	None		

NEW JERSEY

California Refining Co.:						
Barber	S-C-A	25,000	6,000			Pennsylvania; Jersey Central
Cities Service Oil Co. (Pa.):						
Linden	S-A	15,000				
Pettys Island	S-A	10,000				
Esso Standard Oil Co.:						
Linden, Bayonne, and Jersey City	Comp.	173,000	54,000	50,000	F	Pennsylvania; Jersey Central; Lehigh Valley
Socony-Vacuum Oil Co., Inc.:						
Paulsboro	Comp.	58,000	9,200	22,000	H; T	
Texas Co.:						
Westville	S-C	40,000	9,000	50,000	F	Pennsylvania-R.S.L.
Tide Water Associated Oil Co.:						
Bayonne	Comp.	74,000	8,900	26,000	H; T	Lehigh Valley; Jersey Central
Total		395,000	87,100	148,000		

1. Includes 2,000-bbl. daily reforming capacity.
2. Includes reforming and vis-breaking capacity. Polymerization production 2,000 bbl. daily.
3. Includes 8,000-bbl.-per-day crude oil charged directly to cracking units.
4. Reforming capacity 3,200 bbl. daily; vis-breaking capacity 6,000 bbl. daily. Alkylation production capacity 500 bbl. daily.
5. Reforming capacity. Polymerization production capacity 2,500 bbl. daily.
6. Includes 2,900 bbl. daily reforming capacity. Polymerization production capacity 3,500 bbl. daily.

NEW MEXICO

Arex Co.:						
Bloomfield	S	200				None
Continental Oil Co.:						
Artesia	S-C	3,400	1,450			A.T.&S.F.
Farmington	S	750				D.&R.G.W.
Malco Refineries, Inc.:						
Roswell	S-C	2,500	1,000			A.T.&S.F.
McNutt Oil & Refining Co., Inc.:						
Brickland	S-C	3,000	1,200			A.T.&S.F.; S.P.
New Mexico Asphalt & Refining Co.:						
Artesia	S-C	4,000	2,000			A.T.&S.F.
Petroleum Products Refining & Prod. Co.:						
Prewitt	S-C	1,800	600			A.T.&S.F.
Warren Petroleum Corp.:						
Monument	S	600				
Total		16,250	6,250	None		

NEW YORK

Frontier Oil & Refining Co.:						
Tonawanda	S-C	10,000	2,500			
Gulf Oil Corp.:						
Staten Island	S	20,000				G.P.-S.I.; N.Y.
Sinclair Refining Co.:						
Wellsville	Comp.	9,000	8,000			Erie; B.&O.
Socony-Vacuum Oil Co., Inc.:						
Brooklyn	Comp.	26,000	8,400	9,000	H	
Buffalo	Comp.	22,000	6,000	9,000	H	
Olean	S-L	7,000				
Total		94,000	24,900	18,000		

1. Includes 2,000-bbl.-per-day reforming capacity.
2. Includes 2,300 bbl. daily regorming capacity.

SURVEY OF OPERATING REFINERIES

OHIO

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Ashland Oil & Refining Co.:						
Canton	S-C	12,000	3,000			
Byerlyte Corp.:						
Heath	S-A	2,000				Pennsylvania; B.&O.; N.Y.C.
Dewese Oil Refinery:						
Weston	S-L-W	500				
Gulf Refining Co.:						
Cleves	S-C	28,000	[1]2,300	12,000	F	Pennsylvania
Toledo	S-C	40,000	13,200	12,000	F	Pennsylvania
National Refining Co.:						
Findlay	S-C	9,500	5,800			Nickel Plate
Pure Oil Co.:						
Newark	S-C	15,500	[3]9,000	4,500	F	N.Y.C.; B.&O.; Pennsylvania
Toledo	S-C	29,400	18,700			Toledo Terminal
Standard Oil Co. (Ohio):						
Cleveland	Comp.	42,500	[4]36,000	21,000	H	B.&O.; Erie
Toledo	Comp.	21,000	[5]31,000			Toledo Terminal
Lima	Comp.	30,500	[6]25,500	20,000	F	B.&O.; Erie; Nickel Plate
Sun Oil Co.:						
Toledo	S-C	50,000	[7]17,000	30,500	H; Hf	Bay Terminal
Western Reserve Refining Co.:						
Niles	S	2,200				Pennsylvania
Total		283,100	171,500	100,000		

1. Polymerization production capacity 1,500 bbl. daily.
2. Polymerization production 1,500 bbl. daily.
3. Includes 1,800-bbl. daily reforming capacity.
4. Includes reforming and vis-breaking capacity. Polymerization production capacity 200 bbl. daily.
5. Includes reforming and vis-breaking capacity.
6. Includes 9,000-bbl.-per-day reforming capacity. Polymerization capacity 500 bbl. daily.
7. Includes 5,500-bbl.-per-day reforming capacity and 8,500-bbl.-per-day vis-breaking capacity. Alkylation production capacity 1,800 bbl. daily. Polymerization production capacity 500 bbl. daily.
8. Includes 6,000-bbl.-per-day reforming capacity and 8,500-bbl.-per-day coking and recycle capacity. Polymerization production capacity 550 bbl. daily. After July 1, refinery is scheduled to produce 1,800 bbl. per day of lubricating oils.
9. Polymerization production capacity 1,000 bbl. daily.

OKLAHOMA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Allied Materials Corp.:						
Stroud	S-A	1,800				St.L.&S.F.
Anderson-Prichard Oil Corp.:						
Cyril	S-C	10,000	[1]5,000			St.L.&S.F.
Bareco Oil Co.:						
Barnsdall	W	[2]				Midland Valley
Bell Oil & Gas Co.:						
Granfield	S-C	6,000	4,000			M.K.&T.
Ben Franklin Refining Co.:						
Ardmore	S-C	6,000	[3]7,600			A.T.&S.F.; St.L.&S.F.
Champlin Refining Co.:						
Enid	Comp.	20,000	[4]12,500			C.R.I.&P.; A.T.&S.F.; St.L.&S.F.
Cities Service Oil Co. (Del.):						
Ponca City	S-C	13,000	4,500			C.R.I.&P.; A.T.&S.F.
Continental Oil Co.:						
Ponca City						
Deep Rock Oil Corp.:	Comp.	[5]2,500	[6]12,500	16,750	T	C.R.I.&P.; A.T.&S.F.
Cushing	Comp.	[7]16,000	[8]10,000	5,000	F	A.T.&S.F.; M.K.&T.
Indian Royalty Co.:						
Edmond	S	2,000				A.T.&S.F.
Johnson Oil Refining Co.:						
Cleveland	S-C	6,000	[9]2,750			M.K.&T.
Kerr-McGee Oil Industries, Inc.:						
Wynnewood	S-C	6,500	[10]2,000			A.T.&S.F.
Mercury Oil Refining Co.:						
Oklahoma City	S-C	5,000	1,500			A.T.&S.F.
Mid-Continent Petroleum Corp.:						
West Tulsa	Comp.	45,000	[11]17,000	15,000	F	St.L.&S.F.; A.T.&S.F., M.K.&T.; Midland Valley
Midland Cooperative Wholesale:						
Cushing	S-C	6,500	[12]2,500			M.K.&T.; A.T.&S.F.
Monarch Refineries, Inc.:						
Oklahoma City	S	1,000				C.R.I.&P.
Peppers Refining Co.:						
Oklahoma City	S-C	1,200	[13]500			St.L.&S.F.
Phillips Oil Co.:						
Okmulgee	S-C	8,000	[14]1,800			Okmulgee Northern
Sunray Oil Corp.:						
Duncan	S-C	20,000	[15]5,000	15,000	F	C.R.I.&P.
Texas Co.:						
West Tulsa	S-C	30,000	[16]14,000	15,000	F	Midland Valley; St.L.&S.F.
Tide Water Associated Oil Co.:						
Drumright	S-C	12,000	5,000	4,500	Hf	A.T.&S.F.; St.L.&S.F.
Wilcox Oil Co.:						
Bristow	S-C	5,000	2,200			St.L.&S.F.
Total		273,800	110,150	71,250		

1. Polymerization production capacity 150 bbl. daily.
2. Plant processes no crude oil.
3. Includes 1,000-bbl.-per-day reforming capacity. Polymerization production capacity 50 bbl. daily.
4. Includes 4,000-bbl.-per-day reforming capacity. Polymerization production capacity 80 bbl. daily.
5. Includes 3,500-bbl.-per-day reforming capacity. Polymerization production capacity 500 bbl. daily.
6. Includes 3,500-bbl.-per-day hydroforming capacity; 4,000-bbl.-per-day thermal cracking and 3,500-bbl.-per-day hydroforming capacity not currently operating.
7. Expanded capacity as of June 1950. Includes 2,000-bbl.-per-day reforming capacity and 6,000-bbl.-per-day vis-breaking capacity. Polymerization production capacity 300 bbl. daily.
8. Polymerization production 75 bbl. daily.
9. Vis-breaking capacity.
10. Includes 6,000-bbl.-per-day reforming capacity and 4,000 bbl.-per-day vis-breaking capacity. Polymerization production capacity 1,500 bbl. daily.
11. Includes 1,500-bbl.-per-day reforming capacity. Polymerization production capacity 50 bbl. daily.
12. Reforming capacity.
13. Gasoline production capacity including polymerization operations.
14. Vis-breaking capacity. Polymerization production capacity 1,000 bbl. daily.
15. Polymerization production capacity 150 bbl. daily.

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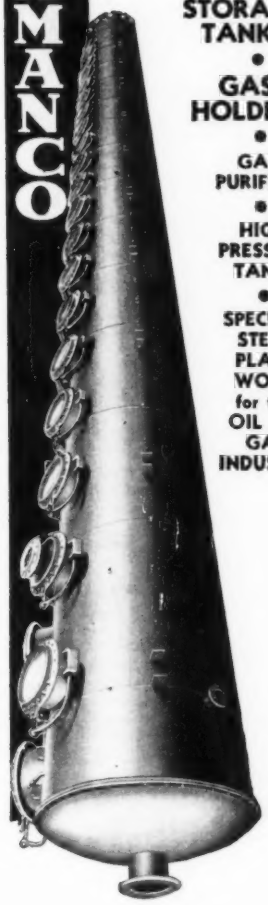

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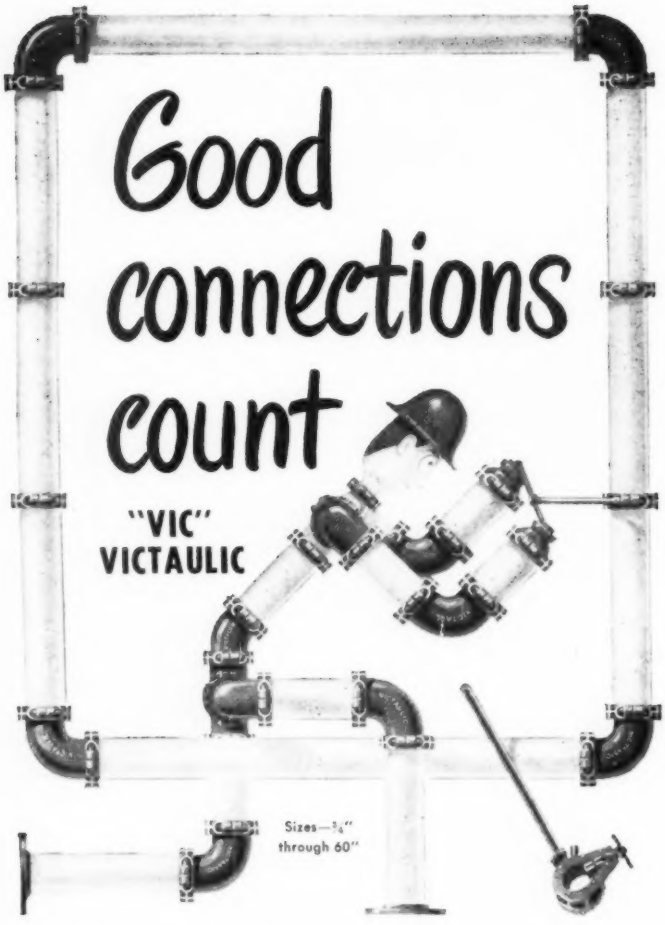

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OREGON

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
California Asphalt Corp.:						
Portland	S-A	4,200				
Shell Oil Co.:						
Portland	A	(1)				
Total		4,200	None	None		

1. Operates on reduced crudes to produce asphalt.

PENNSYLVANIA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Atlantic Refining Co.:						
Philadelphia	Comp.	117,000	(1)	(1)		
Cities Service Oil Co. (Pa.):						
Titusville	S-L-W	3,000				
Cintinental Refining Co.:						
Oil City	L	(2)				
Freedom-Valvoline Oil Co.:						
Freedom	Comp.	4,000	1,750			Pennsylvania
Gulf Oil Corp.:						
Neville Island	S-C	14,000	6,000			P.&O.V.
Philadelphia	S-C-L	107,000	[3]31,200	25,000	F	Pennsylvania
Kendall Refining Co.:						
Bradford	Comp.	5,000	[4]2,200			Erie; B.&O.; Pennsylvania
Pennsylvania Refining Co.:						
Karns City	S-L-W	1,400				B.&O.
Pennzoil Co.:						
Rouseville	Comp.	8,500	[5]5,850	[6]2,825	F	Pennsylvania
Quaker State Oil Refining Corp.:						
Bradford	Comp.	4,200	1,350			Pennsylvania
Emlenton	Comp.	2,000	1,350			Pennsylvania
Oil City	Comp.	2,800	[7]1,200	[7]1,050	(7)	Pennsylvania
Sonneborn, L., Sons, Inc.:						
Franklin	S-L	2,000				Erie
Petrolia	S-L-W	4,000				B.&O.
Sinclair Refining Co.:						
Marcus Hook	S-C	80,000	[8]32,000	30,000	F	Reading; Pennsylvania
Sun Oil Co.:						
Marcus Hook	Comp.	140,000	[9]24,000	84,500	H	Reading; Pennsylvania
United Refining Co.:						
Warren	Comp.	5,500	[10]2,200			Pennsylvania
Waverly Oil Works Co.:						
Pittsburgh	S-L-W	2,500				Pennsylvania
Wolf's Head Oil Refining Co., Inc.:						
Reno	Comp.	2,500	[11]620	[11]720	(11)	Erie; N.Y.C.
Total		505,400	109,720	144,095		

1. Capacities not reported.
2. Plant processes reduced crude for production of lubes.
3. Includes 750-bbl.-per-day reforming capacity. Polymerization production capacity 50 bbl. daily.
4. Alkylation production capacity 2,400 bbl. daily.
5. Includes 700-bbl.-per-day reforming capacity. Polymerization production 100 bbl. daily.
6. Portion of jointly owned facilities. Polymerization production capacity 280 bbl. daily.
7. Portion of jointly owned facilities.
8. Includes 8,000-bbl.-per-day reforming capacity. Polymerization production capacity 1,850 bbl. daily.
9. Reforming capacity.
10. Polymerization production capacity 100 bbl. daily.
11. Portion of jointly owned facilities.

RHODE ISLAND

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
American Bitumuls Co.:						
East Providence	S-A	1,500				N.Y.N.H.&H.
Socony-Vacuum Oil Co., Inc.:						
East Providence	S-C-A	8,000	1,400			N.Y.N.H.&H.
Texas Co.:						
Providence	S	3,500				N.Y.N.H.&H.
Total		13,000	1,400	None		

SOUTH CAROLINA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Esso Standard Oil Co.:						
Charleston	S-A	6,500				A.C.L.; S.A.L.

SOUTH DAKOTA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Hot Springs Refining Co.:						
Hot Springs	S	200				None
How Kola Refining Corp.:						
Sturgis	S	105				C.&N.
Rex Refining Co.:						
Rapid City	S	100				None
Total		405	None	None		

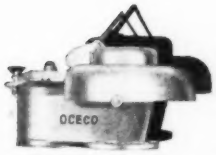
TENNESSEE

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
Delta Refining Co.:						
Memphis	S-C	4,000	1,200			I.C.
Southern Oil Service:						
Nashville	S	1,000				T.C.
Total		5,000	1,200	None		

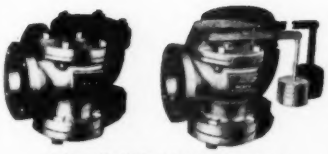
SURVEY OF OPERATING REFINERIES

TEXAS

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
American Liberty Oil Co.:						
Mount Pleasant	S-C-A	14,000	[1]4,000			St. L. Southwestern
Atlantic Refining Co.:						
Port Arthur	S-C	40,000	(2)	(2)	F	
Coastal Refineries, Inc.:						
Port Isabel	S-C	[3]6,000	(3)			Mo. P.
Col-Tex Refining Co.:						
Colorado City	S-C-A	12,000	4,000			T.&P.
Consumers Co-op Refinery Association:						
Levelland	S-C	5,000	2,600			A.T.&S.F.; Panhandle
Continental Oil Co.:						
Wichita Falls	S-C	6,750	[4]4,200			M.K.&T.
Cosden Petroleum Corp.:						
Big Spring	S-C-A	18,000	[5]8,000	[5]8,000	F	T.&P.
Crown Central Petroleum Corp.:						
Houston	S-C-L	26,000	[6]8,500	15,000	T	
Danaho Refining Co.:						
Pettus	S-C	4,000	1,000			T.&N.O.
Dodds Refining Co., Inc.:						
Jacksonville	S	1,000				St. L. Southwestern
Eastern States Petroleum Co., Inc.:						
Houston	S-C	37,500	[7]16,000	10,000	F	Port Terminal Ry. Assn.
Eddy Refining Co.:						
Houston	S	2,000				M.K.&T.; T.&N.O.; I.&G.N.
Gladewater Refining Co.:						
Gladewater	S-C	3,000	1,500			T.&P.
Great Southern Corp.:						
Corpus Christi	C		4,000			
Gulf Oil Corp.:						
Fort Worth	S-C	9,500	4,000			Fort Worth Belt
Port Arthur	Comp.	230,000	[8]84,200	34,000	T; H	T.&N.O.; K.C.S.
Sweetwater	S-C	10,000	4,000			T.&P.; G.C.&S.F.
Humble Oil & Refining Co.:						
Baytown	Comp.	260,000	[9]83,500	57,900	F	Mo. P.; S.P.
San Antonio	S	7,000				Mo. P.; S.P.
Inland Refining Co., Inc.:						
Palestine	S-C	2,000	1,020			I.&G.N.
Lacy, R., Inc.:						
Big Sandy	S-C-A	3,000	1,000			
LaSalle Petroleum Corp.:						
Burkburnett	S	1,500				M.K.&T.
Magnolia Petroleum Co.:						
Beaumont	Comp.	150,000	[10]55,000	62,400	H; T	K.C.S.; S.P.
Fort Worth	S-C	12,000	[11]1,800			T.&P.; M.K.&T.
Maritime Oil Co.:						
Houston	S	5,000				
Master Petroleum Co.:						
Dallas	S-L-A	2,000				
McBride Refining Co.:						
La Blanca	S-L-A	2,500				
McMurrey Refining Co.:						
Tyler	S-C	9,000	4,500			
Mex-Tex Oil Co.:						
Rio Grande City	S	200				Mo. P.
Monarch Refining Co.:						
San Antonio	S	1,000				Mo. P.
Onyx Refining Co.:						
Abilene	S-C	3,500	[12]2,080			Wichita Valley
Pan American Refining Corp.:						
Texas City	S-C	114,000	(13)	27,000	F	Texas City Terminal
Panhandle Producing & Refining Co.:						
Wichita Falls	S-C	5,000	[14]1,950	1,500	F	M.K.&T.
Patton Oil Co.:						
Rotan	S	1,500				M.K.&T.
Peerless Tank Cleaning Co.:						
Kilgore	S	1,000				T.&P.
Petrolite Corp.:						
Kilgore	S-W	700				I.&G.N.
Phillips Oil Co.:						
Borger	S-C	56,000	[15]23,000			A.T.&S.F.; C.R.I.&P.
Sweeny	S-C	45,000	[15]11,000	(15)	F	St. L., Brownsville & Mexico
Pontiac Refining Corp.:						
Corpus Christi	S	20,000				
Premier Petroleum Co.:						
Arp	S-C	5,000	3,000			I.&G.N.
Baird	S-C	2,500	1,500			T.&P.
Longview	S-C	4,000	1,600			T.&P.; M.K.&T.
Pure Oil Co.:						
Nederland	Comp.	55,000	[11]15,200	9,800	T	K.C.S.
Rado Refining Co.:						
McAllen	S	3,000				Mo. P.
Reischman, R. J.:						
Fort Stockton	S	200				
Republic Oil Refining Co.:						
Texas City	S-C	16,000	[16]26,500	14,000	F	Texas City Terminal
Shamrock Oil & Gas Corp.:						
Sunray	S-C	7,500	4,000			C.R.I.&P.
Shell Oil Co.:						
Deed Park (Houston)	Comp.	110,000	[16]46,000	33,000	F	Port Terminal
Sid Richardson Refining Co.:						
Texas City	S-C	25,000	10,000			

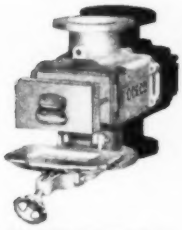


V-113 VENT VALVES control tank breathing, minimizing vapor losses and deterioration of product. High flow capacity. 2" to 12" sizes. ½ oz. to 8 oz. pressure or vacuum settings.



V-103 VACUUM RELIEF AND V-106 PRESSURE RELIEF VALVES are furnished in 3", 4" and 6" sizes. Vacuum settings from 1½ oz. to 1 lb. per sq. inch. Pressure settings from 2 lbs. to 30 lbs. per sq. inch. Working temperatures up to 600° F.

V-114 INTERNAL TANK VALVES are provided with a fusible link that melts when subjected to fire, closing the valve instantly, and cutting off the flow from the tank. 3", 4", 6", 8" and 10" sizes.



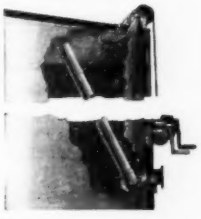
TYPE "E" FLAME ARRESTORS can withstand long exposure to fire. The "banks" have vertical straight through passages—minimizing entrainment and pressure drop, and are "extensible" for easy cleaning. 2" to 10" sizes.

OCECO FITTINGS

Prevent VAPOR AND FIRE *Losses*

V-108 EMERGENCY PRESSURE RELIEF VENTS provide instant relief for excessive internal pressures, resulting from exposure fires, etc. Furnished in 6", 8", 10", 15¼" and 20½" sizes.

TYPE "BE" VENT UNITS consist of a V-115 Vent Valve with snuffer, mounted on a Type "E" "Extensible" Bank Flame Arrestor. 2" to 10" sizes. Unsurpassed for efficiency and reliability.



SWING LINE EQUIPMENT – complete facilities including heavy duty tank nozzle; efficient double elbow swing joint; swing pipe; cable clamp; cable; sheave bracket and internal or external winch.

V-109 STILL TYPE VALVES combine vacuum and pressure relief in a single valve. 3", 4" and 6" sizes. Pressure settings from 2 to 25 lbs. per sq. inch. Vacuum settings from 1 oz. to 10 oz. Temperatures up to 600° F.

SEND FOR THE OCECO DATA SHEETS. Ask for sheets on the individual fittings in which you are most interested, or send for the complete set. WRITE TODAY.

● Oceco Vents eliminate the free discharge of vaporized liquids. They control tank breathing resulting from temperature changes and pumping – protect the quality of the stored product – and prevent "blow-outs" and "cave-ins". Oceco Flame Arrestors are a positive flame stop – they prevent explosions and fires.

Specify Oceco Fittings *throughout* for *all* your tanks – and get proven, dependable, trouble-free protection for only a fraction of one per-cent of the value of the tank and its contents.

A few of the most popular Oceco fittings are illustrated and described briefly herewith. But send for the Oceco Data Sheets. They give full details and specifications, and complete listings of sizes, weights, dimensions, etc. Let the Oceco Engineers – pioneers in this work – help you equip your tanks for utmost safety and economy.

Please note the new address:

OCECO

THE JOHNSTON & JENNINGS COMPANY

4700 West Division Street • Chicago 51, Illinois

★ ★ *division of* **PETTIBONE MULLIKEN CORPORATION** ★ ★

? HAVING TROUBLE PUMPING HEAVY OILS?
CONCERNED ABOUT LOSSES RESULTING FROM VOLUME SHRINKAGE AT LOW OIL DELIVERY TEMPERATURES? ...THEN INSTALL

Paracoil TANK SUCTION HEATERS

TO SOLVE YOUR PROBLEMS

TANK SUCTION HEATER INSTALLATION

The shell is open at the inside end. The oil moves across the heating tubes as it passes through the shell to the suction connection outside the tank.

In Bulk Oil Terminals and Refineries the world over Paracoil Tank Suction Oil Heaters are licking the problem of economically preheating heavy viscous oils to permit their withdrawal from storage tanks. They are also preheating the lighter grades of fuel oils to their proper delivery temperatures to avoid the costly volume losses incurred when such oils are sold at low temperatures.

WITH PARACOIL TANK SUCTION OIL HEATERS

- **You Heat Only The Oil That Is Being Withdrawn From The Tank.** (Thus radiation losses resulting from heating entire tank contents are eliminated.)
- **Overall Steam Consumption And Heating Costs Are Held To A Minimum.**
- **Heater Tube Bundle Can Be Withdrawn For Inspection And Cleaning.** Breaking of oil suction line not necessary.
- **All Piping Connections And Gaskets Are Outside The Tank.**
- **U-Tube Design Permits Free Expansion And Contraction Of Tube Bundle.** Either high or low pressure steam can be used as the heating medium.

Prompt Shipments!
Our extensive stocks of tubing and pipe enable us to make quick deliveries to meet your immediate requirements.
Write for Descriptive Literature

SPEED UP DELIVERIES AND CUT OIL VOLUME LOSSES WITH PARACOIL TANK SUCTION HEATERS

In addition to the Paracoil Tank Suction Heaters, we also design and fabricate Line Type Discharge Heaters of any capacity. Illustrated is a Paracoil Straight Tube Type Fuel Oil Heater for bulk station service—capacity 2,000 gallons per minute, No. 6 oil, 100°F to 160°F, steam at 15 psig. Weight 12 tons.

DAVIS ENGINEERING CORPORATION

1060 East Grand Street, ELIZABETH 4, NEW JERSEY
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MERCOID

OFFERS A LINE OF DEPENDABLE CONTROLS FOR VARIOUS INDUSTRIAL REQUIREMENTS

THE ONLY 100% MERCURY SWITCH EQUIPPED CONTROLS THEY ASSURE ACCURACY, BETTER PERFORMANCE AND LONGER CONTROL LIFE

Wherever the control of temperature, pressure, liquid level or mechanical operations are involved, Mercoid Controls and Switches assure a maximum in efficient and dependable performance.

PRESSURE CONTROLS
Available for numerous industrial applications. They are equipped with Bourdon tubes and have outside double adjustments which eliminate guesswork when setting controls. Indicators show the operating range on the calibrated dial.

REMOTE STEM TEMPERATURE CONTROLS
For control of liquids or gases, such as air, oil, water, paraffin, glue or distillate vapors and many other industrial applications. A heavy gauge Bourdon tube is employed which is actuated by the expansion of volatile liquid within the remote bulb. The control is equipped with convenient outside double adjustments.

LEVER ARM AND FLOAT CONTROLS
Mercoid lever arm controls have a variety of applications where it is desired to mechanically open and close electric circuits. Mercoid float controls are used for maintaining fluid levels in tanks or for control of sump pumps or cellar drainers.

LINE VOLTAGE THERMOSTAT
The No. 855 thermostat is used for line voltage applications where it is desired to handle the full motor load directly without the use of a relay. Available with "on-off" manual switch for unit heater applications. These thermostats are used for both heating and refrigeration applications.

TRANSFORMER-RELAYS
Type V is a reliable low voltage mercury contact relay which also acts as a transformer inducing low voltage (24 volts) on the pilot circuit. There is no hum or chatter. Used for all types of automatic equipment. Available in various voltages, cycles and circuits.

MERCURY SWITCHES
Mercoid brand switches are noted for their superior operating qualities. Various types available.

MERCOID CONTROLS are available in a variety of types for sensitive control of Pressure, Temperature and Lever actuation.

Write for further information.

THE MERCOID CORPORATION
4201 BELMONT AVE ★ ★ CHICAGO, ILL.

TEXAS (Continued)

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Sinclair Refining Co.:						
Corpus Christi	S-C	21,000	[2]11,000	11,000	H	Mo. P.
Houston	Comp	85,000	[2]38,000	22,000	H, T	Port Terminal; S.P.
Skelly Oil Co.:						
Longview	S-C	5,000	3,000			T.&P.; G.C.&S.F.
Southwestern Oil & Refining Co.						
Corpus Christi (1)	S	15,000				Mo. P.
Corpus Christi (2)	S-C	10,000	5,000			Mo. P.
Standard Oil Co. of Texas:						
El Paso	S-C	18,000	6,000			T.&N.O.
Taylor Refining Co.:						
Corpus Christi	S-C	22,500	[3]			Mo. P.
Texas Co.:						
Amarillo	S-C	8,000	[4]4,000			F.W.&D.C.
El Paso	S-C	5,000	3,000			T.&N.O.; T.&P.
Port Arthur	Comp	190,000	[5]121,000	63,000	F	K.C.S.; T.&N.O.
Port Neches	S-A	40,000				K.C.S.
Three Rivers Refinery:						
Three Rivers	S-L-A	1,500				
Tydal Co.:						
Gainesville	S	2,000				M.K.&T.
Ute Oil & Refining Co.						
Graham	S	700				C.R.I.&P.
W. T. Waggoner Estate						
Vernon	S-C	6,500	2,500			F.W.&D.C.
Wickett Refining Co.						
Wickett	S-C	4,000	500			T.&P.
Total		1,789,050	632,650	368,600		

1. Polymerization production capacity 200 bbl. daily.
2. Capacities not reported.
3. Combination unit, cracking capacities not reported.
4. Includes 1,000-bbl.-per-day reforming capacity. Polymerization production capacity 650 bbl. daily.
5. Capacity based on 50 per cent conversion. Polymerization production capacity 1,450 bbl. daily.
6. Includes 1,000-bbl. daily reforming capacity.
7. Includes 13,000-bbl.-per-day vis-breaking capacity. Polymerization production 700 bbl. daily.
8. Alkylation production capacity 3,200 bbl. daily. Polymerization production capacity 500 bbl. daily.
9. Includes 12,300-bbl.-per-day reforming capacity. Alkylation production capacity 6,500 bbl. daily. Polymerization production capacity 3,600 bbl. daily.
10. Includes 12,000-bbl.-per-day reforming capacity and 38,000-bbl.-per-day vis-breaking capacity. Alkylation production capacity 3,500 bbl. daily. Polymerization production capacity 360 bbl. daily.
11. Polymerization production capacity 300 bbl. daily.
12. Includes 1,080-bbl.-per-day reforming capacity.
13. Thermal cracking operations are carried out in combination units having a crude-oil charging capacity of approximately 103,000 bbl. per day. Alkylation production capacity 3,500 bbl. daily. Polymerization production capacity 2,400 bbl. daily.
14. Includes 450-bbl.-per-day reforming capacity. Polymerization production capacity 150 bbl. daily.
15. Production capacity on gasoline from thermal cracking and alkylation operations.
16. Production capacity on gasoline from thermal and catalytic cracking operations.
17. Includes reforming and vis-breaking capacity. Alkylation production capacity 2,000 bbl. daily. Polymerization production capacity 800 bbl. daily.
18. Includes 12,500 bbl. per day of vis-breaking capacity and 5,000 bbl.-per-day reforming capacity which is not operating. Polymerization production capacity 1,000 bbl. daily.
19. Includes 17,000-bbl.-per-day reforming capacity. Alkylation production capacity 4,000 bbl. daily.
20. Includes 3,000-bbl.-per-day reforming capacity. Alkylation production capacity 1,700 bbl. daily.
21. Includes 8,000-bbl.-per-day reforming capacity. Alkylation production capacity 1,800 bbl. daily.
22. Combination unit, cracking capacity not reported.
23. Polymerization production capacity 150 bbl. daily.
24. Includes 12,000-bbl.-per-day reforming capacity. Alkylation production capacity 12,000 bbl. daily. Polymerization production capacity 3,000 bbl. daily.

UTAH

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Phillips Petroleum Co.						
Woods Cross	S-C-A	4,200	800			U.P.
Salt Lake Refining Co.:						
North Salt Lake	S-C	25,000		10,000	H	U.P.
Utah Oil Refining Co.:						
Salt Lake City	S-C	23,500	7,200	12,300	F	U.P.
Western States Refining Co.						
North Salt Lake	S	3,500				U.P.; D.&R.G.W.
Total		56,200	8,000	22,300		

1. Capacity reported on production basis and includes polymerization.
2. Catalytic cracking facilities to be constructed in 1950.
3. Alkylation production capacity 3,800 bbl. daily.

WASHINGTON

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Phillips Petroleum Co.						
Spokane	S-C	5,500	1,000			G.N.

1. Cracking capacity reported on production basis and includes polymerization operations.

WEST VIRGINIA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking: Capacity bbl. per day	Catalytic cracking: Type of unit	Railroads serving refinery
Carbide Carbon Chemicals Co.						
Charleston	S-C	2,500	1,200			
Elk Refining Co.						
Falling Rock	Comp	5,000	2,000			B.&O.
Pure Oil Co.:						
Cabin Creek	Comp	5,500	4,000			C.&O.
Quaker State Oil Refining Corp.						
St. Marys	Comp	2,500	1,350			B.&O.
Total		15,500	8,550	None		

1. Polymerization production capacity 100 bbl. daily.
2. Polymerization production capacity 110 bbl. daily.

WISCONSIN

Company and refinery location—	Refinery type	Crude-oil charge— cap. bbl. per day	Thermal cracking— cap. bbl. per day	Catalytic cracking Capacity bbl. per day	Catalytic cracking Type of unit	Railroads serving refinery
Wisconsin Oil Refining Co., Inc.:						
Sheboygan	S	5,500				C.&N.W.
WYOMING						
C & H Refinery:						
Lusk	S	160				C.&N.W.
Continental Oil Co.:						
Glenrock	S-C	3,400	[1]1,800			C.&N.W.; C.B.&Q.
Cooperative Refinery Association:						
Newcastle	S-C	2,200	800			C.B.&Q.
Empire State Oil Co.:						
Thermopolis	S-A	1,500				
Frontier Refining Co.:						
Cheyenne	S-C-A	10,500	[2]3,500	3,500	F	U.P.
Husky Refining Co.:						
Newcastle	S-A	5,000				C.B.&Q.
Ohio Oil Co.:						
Lovell	S-A	6,000				C.B.&Q.
Resolute Oil Corp.:						
Badger Basin	S	1,000				None
Sinclair Refining Co.:						
Sinclair	S-C-A	20,000	[3]7,000	10,000	F	U.P.
Sioux Oil Co.:						
Newcastle	S	2,500				
Socony-Vacuum Oil Co., Inc.:						
Casper	S-C	6,000		[4]3,000	T	
Standard Oil Co. (Ind.):						
Casper	Comp.	15,200	6,350	8,000	F	C.B.&Q.; C.&N.W.
Texas Co.:						
Calpet	S	400				None
Casper	S-C-A	12,000	[5]4,000	5,000	F	C.B.&Q.; C.&N.W.
Total		85,860	23,450	29,500		

1. Polymerization production capacity 90 bbl. daily.
2. Polymerization production capacity 300 bbl. daily.
3. Includes 2,000-bbl.-per-day reforming capacity. Alkylation production capacity 1,700 bbl. daily. Polymerization production capacity 100 bbl. daily.
4. Polymerization production 210 bbl. daily.
5. Includes 1,000-bbl.-per-day reforming capacity. Polymerization production capacity 500 bbl. daily.

Shutdown Plants in the United States

ARKANSAS

Company and refinery location—	Refinery type	Cap., bbl. per day: Crude oil	Cap., bbl. per day: Cracking
Stephens Ref. Co., Inc., Stephens	S	2,500	
CALIFORNIA			
Eagle Oil & Ref. Co., Santa Fe Springs	S-C-A	5,000	15,000
Economy Asphalt Co., Oxnard	S-A	2,000	
Harbor Ref. Co., Long Beach	S	3,000	
Maritime Pet. Corp., Wilmington	S	1,500	
Shell Oil Co., Coalinga	S	6,700	
Texas Co., Fillmore	S	5,000	
Total		25,700	15,000
ILLINOIS			
Advance Ref. Co., Centralia	S	2,500	
Northwestern Ref. Co., St. Elmo	S-C	5,000	2,000
Pana Ref. Co., Pana	S-C	3,500	1,650
Sol-Tex Ref. Co., Inc., Fairfield	S	2,500	
Total		13,500	3,650
KANSAS			
Chanute Ref. Co., Chanute	S-C	1,000	1,000
Sinclair Ref. Co., Coffeyville	Comp.	13,000	7,000
Kansas City	S-C	12,000	7,000
Total		26,000	15,000
KENTUCKY			
Atomic P. & R. Co., Albany	S	1,500	
LOUISIANA			
Gilcrease Oil Co., Meraux	S	5,000	
Premier Oil Ref. Co. of Texas, Cotton Valley	S	5,000	
Total		10,000	None
MICHIGAN			
Louis Rose Ref. Co., Saginaw	S-C	3,500	1,500
MONTANA			
Big Lake Oil Co., Lake Basin	S	100	
Gallatin Farmers Co., Belgrade	S	250	

Company and refinery location—	Refinery type	Cap., bbl. per day: Crude oil	Cap., bbl. per day: Cracking
Hole Bros. Refinery, Cut Bank	S	350	
North American O. & R. Co., Chinook	S	300	
Patterson, H. F., Ref. Co., Sweet Grass	S	800	
Solar O. & R. Co., Soap Creek field	S	1,500	
Treasure State Ref. Co., Shelby	S	500	
Tri-Petroleum Corp., Hardin	S	3,000	
Total		6,800	None
NEBRASKA			
Oil Marketing & Ref., Inc., Salem	S	800	
OKLAHOMA			
Anderson-Prichard Oil Corp., Cement	S	2,000	
Rock Island O. & R. Co., Inc., Beckett	S-C	10,000	4,000
Sunray Oil Corp., Allen	S-C	5,000	10,000
Total		17,000	14,000
TEXAS			
American Mineral Spirits Co., Corpus Christi	S	12,000	
Baird Ref. Co., Baird	S-C	2,500	2,750
Bennett O. & R. Co. of Texas, Refugio	S	1,500	
Bryson P. L. & Ref. Co., Bryson	S	1,200	
Hamman O. & R. Co., Bay City	S	2,100	
Muenster Ref. Co., Muenster	S	750	
Owen Ref. Co., Hawley	S	1,100	
Panhandle P. & R. Co., Leuders	S	1,500	
Payward Ref. Co., Shamrock	S	1,000	
Petrol Ref. Co., Inc., Texas City	S-C	50,000	10,000
Pioneer O. & R. Co., Somerset	S	2,000	
Premier Pet. Co., Fort Worth	Comp.	8,000	5,000
Rosewood O. & R. Co., Bishop	S	3,000	
Winnsboro Ref. Co., Winnsboro	S	3,000	
Total		89,650	17,750
WYOMING			
Husky Ref. Co., Lovell	S-A	2,000	
Standard Oil Co. (Ind.), Greybull	S-C-A	6,000	1,500
Upton Refinery, Upton	S	100	
Wheatland Ref. Co., Wheatland	S	200	
Total		8,300	1,500

OPERATING REFINERIES IN CANADA

SUMMARY OF REFINERIES IN CANADA—THEIR DISTRIBUTION AND CAPACITY*

	Operating plants		
	No. plants	Crude oil capacity	Cracking capacity†
Alberta	7	48,150	17,400
British Columbia	3	28,350	5,750
Manitoba	2	7,300	3,200
New Brunswick	1	300	
Northwest Territory	1	1,000	
Nova Scotia	1	22,000	9,900
Ontario	3	66,000	33,500
Quebec	4	134,500	94,650
Saskatchewan	7	32,100	15,500
Total	29	339,700	179,900

*Barrels per day basis. †Includes reforming, vis-breaking, thermal cracking, and catalytic cracking capacities.

ALBERTA

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
British American Oil Co., Ltd.:						
Calgary	S-C-A	7,200	2,500			Canadian National and Canadian Pacific
Excelsion Refineries, Ltd.:						
Lloydminster	S-C-A	2,000	[1]1,900			Canadian National
Husky Oil & Refining, Ltd.:						
Lloydminster	S-A	7,500				Canadian National and Canadian Pacific
Lloydminster	S-A	5,000				Canadian National and Canadian Pacific
Imperial Oil, Ltd.:						
Calgary	S-C-A	10,000	[2]4,000			Canadian National and Canadian Pacific
Edmonton	S-C	16,200	9,000			Canadian National and Canadian Pacific
Wainwright Refineries, Ltd.:						
Wainwright	S	250				Canadian National
Total		48,150	17,400	None		

1. Includes 900-bbl.-per-day vis-breaking capacity.
2. Alkylation production 950 bbl. daily.
3. Two refineries, McColl-Frontenac and Trinidad Leaseholds.

presumed to be shut down since no report on their current status was received.

BRITISH COLUMBIA

Imperial Oil, Ltd.:						
Ioco	Comp.	12,000	2,750			Canadian Pacific and Canadian National (via Yorke & Sons barge)
Shell Oil Co. of Canada, Ltd.:						
North Burnaby, Vancouver	S-C-A	8,000	[3]3,000			Canadian Pacific
Standard Oil Co. of British Columbia, Ltd.:						
Burnaby, Vancouver	S-L-A	8,350				Canadian Pacific
Total		28,350	5,750	None		

1. Includes 400-bbl.-per-day reforming capacity.

MANITOBA

Anglo-Canadian Oils, Ltd.:						
Brandon	S-C	2,300	[1]1,600			Canadian National and Canadian Pacific
North Star Oil, Ltd.:						
St. Boniface	S-C	5,000	[2]1,600			Canadian Pacific
Total		7,300	3,200	None		

1. Includes 500-bbl.-per-day reforming capacity. 2. Includes 600-bbl.-per-day reforming capacity.

NEW BRUNSWICK

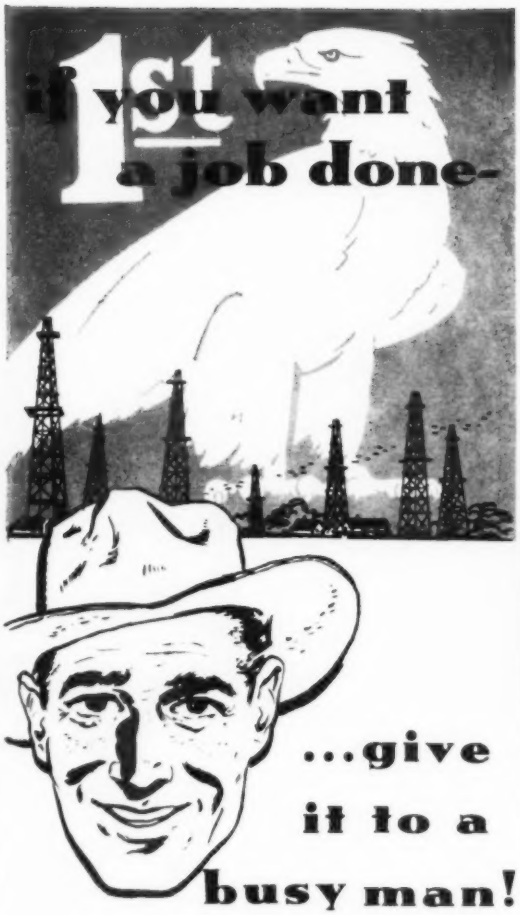
New Brunswick Oilfields, Ltd.:						
Moncton	S	300				Canadian National

NORTHWEST TERRITORY

Imperial Oil, Ltd.:						
Norman Wells	S	1,000				N.A.

NOVA SCOTIA

Imperial Oil, Ltd.:						
Halifax	S-C-A	22,000	9,900			Canadian National



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The broad experience, resources, facilities and service of the First National in Dallas have made it the Southwest's leading oil bank.

First National Bank in Dallas 1st NATIONAL

NOT CHEAP TO BUY BUT HOW IT CAN CUT COSTS

Proved long life and effective resistance to corrosion make cast iron pipe a valiant ally in cutting maintenance costs.

Avoided, or fewer, replacements of pipe lines means direct economy. Less interference with production, caused by such replacements, means indirect economy.

As a conduit for carrying corrosives, standard cast iron pipe offers longer life and lowest cost per service year. Alloy cast iron pipe is available for super-corrosive service. Your choice of bell-and-spigot, plain end and flanged, or standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE FOR LONG LIFE AND ECONOMY

ONTARIO

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
British American Oil Co., Ltd.:						
Clarkson	Comp	10,000	4,500			Canadian National and Canadian Pacific
Canadian Oil Companies, Ltd.:						
Petrolia	S-C-L[1]	4,000	3,000			Canadian National and Michigan Central
Imperial Oil, Ltd.:						
Sarnia	Comp	52,000	3,000	23,000	S	Canadian National and C.&O.
Total		66,000	10,500	23,000		

1. Lube oil facilities not operating.
2. Includes 1,000-bbl.-per-day reforming capacity.
3. Vis-breaking capacity.

QUEBEC

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
British American Oil Co., Ltd.:						
Montreal East	S-C-A	32,000	[2]7,500	13,350	F	Canadian National
Imperial Oil, Ltd.:						
Montreal East	S-C-A	37,500	[3]11,300	12,000	F	Canadian National and Canadian Pacific via National Harbours Board
McColl-Frontenac Oil Co., Ltd.:						
Montreal East	S-C	40,000	[4]18,000	15,000	F	Canadian National
Shell Oil Co. of Canada, Ltd.:						
Montreal East	Comp	25,000	[1]7,500	10,000	F	Canadian National
Total		134,500	44,300	50,350		

1. Polymerization production 700 bbl. daily.
2. Reforming capacity 3,000 bbl. per day; vis-breaking capacity 8,300 bbl. per day. Polymerization production 4,400 bbl. per day.
3. Includes reforming capacity 3,400 bbl. per day; vis-breaking capacity 9,600 bbl. per day. Polymerization production 850 bbl. daily.
4. Includes capacities on cracking, reforming and vis-breaking. Polymerization production capacity 1,700 bbl. daily.

SASKATCHEWAN

Company and refinery location	Refinery type	Crude-oil charge—cap. bbl. per day	Thermal cracking—cap. bbl. per day	Catalytic cracking—Capacity bbl. per day	Catalytic cracking—Type of unit	Railroads serving refinery
British American Oil Co., Ltd.:						
Moose Jaw	S-C-A	6,000	2,000			Canadian Pacific
Hi-Way Refineries, Ltd.:						
Moose Jaw	S	350				Canadian Pacific
Rosetown	S	350				Canadian National
Saskatoon	S-C-A	2,800	600			Canadian National
Imperial Oil, Ltd.:						
Regina	S-C-A	20,000	[1]2,000			Canadian National and Canadian Pacific
Northern Petroleum Corp., Ltd.:						
Kamsack	S	600				Canadian National
Saskatchewan Federated Co-operatives, Ltd.:						
Regina	S-C	2,000	900			Canadian National
Total		32,100	15,500	None		

1. Includes 3,000-bbl.-per-day reforming capacity. Polymerization production capacity 750 bbl. daily.

OPERATING REFINERIES IN MEXICO

SUMMARY OF REFINERIES IN MEXICO—THEIR DISTRIBUTION AND CAPACITY*

	Operating plants—No. plants	Operating plants—Crude-oil capacity	Operating plants—Cracking capacity
Distrito Federal	**1**	**39,500**	**11,700**
Guanajuato	**1**	**25,000**	**4,000**
Tamaulipas	**2**	**63,850**	**6,400**
Veracruz	**3**	**32,000**	**3,800**
Total	**7**	**160,350**	**25,900**

***Barrels per "calendar day" basis.**

Company and refinery location	Refinery type	Crude-oil charge—Cap., bbl. per day	Thermal cracking—Cap., bbl. per day	Reforming—Cap., bbl. per day	Vis-breaking Cap., bbl. per day	Catalytic cracking—Cap., bbl. per day	Catalytic cracking—Type of unit
Petroleos Mexicanos:							
Arbol Grande, Tamp.	S-A	16,600					
Atzcapotzalco, D. C.	S-C	39,500	11,700				
Ciudad Madero, Tamp.	S-C-A	47,250	*6,400				
Mata Redonda, Ver.	S-C	9,000	3,800				
Minatitlan, Ver.	S-L	19,900					
Poza Rica, Ver.	S	3,100					
Salamanca, Gto.	S-C	25,000	4,000				
Total		160,350	25,900	None	None	None	

*Includes 1,000 bbl. per day of capacity from another unit located at Bella Vista.

Refinery Capacity Being Upped 105,000 Bbl. by Plants Building and Authorized

by R. B. Tuttle

THE OIL AND GAS JOURNAL'S survey on refinery projects for the second quarter of 1950 shows approximately 80,000 bbl. of daily crude-oil capacity is being constructed and another 25,000 bbl. authorized for construction, in the United States. Expansion of Canadian refineries and a new plant recently authorized account for another 16,000 bbl. of daily crude-oil capacity to be added to North American plants.

Among the major projects are the synthesis plant of Carthage Hydrocol, Inc., at Brownsville, Tex.; a new catalytic cracking unit for Salt Lake Refining Co., and the revamping of catalytic cracking equipment in some of Socony-Vacuum Oil Co., Inc.'s. plants. A substantial portion of the projects under way and authorized cover auxiliary equipment.

The Journal's survey on refinery operations shows upwards of 100 refineries now operating in the United States, with crude-oil capacity input in the range of 5,000 bbl. daily and above, are expected to be ready soon for general modernization. The plants in this group are of two general types: (1) distillation, and (2) distillation and thermal conversion. In the first type are about 30 refineries, distributed throughout the country, which have capacity to produce approximately 125,000 bbl. of straight-run gasoline and naphtha daily. The second type covers about 80 nationwide plants with a total gasoline-producing capacity of approximately 700,000 bbl. per day including both straightrun and thermally converted gasolines and other products suitable for motor-fuel blending. No catalytic cracking is incorporated in the processing layout of this group of refineries. However, a number of them are equipped with catalytic operation for producing polymer stocks and for reforming various light materials.

A sharp upturn in the activity on plant modernization is foreseen for this group of 100 or more plants.

ACTIVE REFINERY-BUILDING PROJECTS

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Alba Oil & Refining Co., Alba, Tex.:				
New refinery, bbl. per day	1,000	Building	1950	
Ashland Oil & Refining Co., Catlettsburg, Ky.:				
Addition to cat. poly plant, bbl. per day	1,200	Building	Mar. '50	
Revamp gas-recovery facilities		Building	Feb. '50	
Ashland Oil & Refining Co., Canton, Ohio:				
Alteration to poly and light ends plants		Considering		
Breaux Bridge Oil Refining Co., Inc., Breaux Bridge, La.:				
Thermal cracking unit, bbl. per day	1,150	Building	1950	
Berry Asphalt Co., Stephens, Ark.:				
Refinery expansion		Planned		
British American Oil Co., Ltd., Clarkson, Ont., Canada:				
Propane deasphalting unit, bbl. per day	700	Building	June '50	M. W. Kellogg Co.
Carthage Hydrocol, Inc., Brownsville, Tex.:				
Hydrocarbon synthesis plant, cu. ft. per day	100,000,000	Building	Early '50	A. G. McKee & Co.
California Refining Co., Barber, N. J.:				
Increase refinery capacity including cat. cracker, reformer, alkylation, bbl. per day	25,000	Building		C. F. Braun and M. W. Kellogg Co.
Cities Service Oil Co. (Del.), Chicago:				
Lube-oil compound plant	1,200	Building	July '50	Sumner S. Sollitt & Co.
Cities Service Oil Co. (Pa.), St. Rose, La.:				
Compound plant, bbl. per day	500	Building	Feb. '50	Day and Zimmerman
Cooperative Refinery Association, Newcastle, Wyo.:				
Refinery expansion, bbl. per day	3,000	Considered		
Deep Rock Oil Corp., Cushing, Okla.:				
Catalytic cracking unit and auxiliaries, bbl. per day	5,000	Building	1950	Universal Oil Products, Jones & Laughlin, Brown & Lite Co.
Boiler-plant enlargement, lb. per hr.	40,000	Building	1950	Universal Oil Products, Jones & Laughlin, Brown & Lite Co.
Water-cooling system, g.p.m.	17,000	Building	1950	Universal Oil Products, Jones & Laughlin, Brown & Lite Co.
Crude unit, bbl. per day	4,500	Authorized	May '50	
Derby Oil Co., Wichita, Kans.:				
Cat. cracking and plant changes		Considering		
Empire Petroleum Co., Denver:				
Crude distillation unit, bbl. per day	3,000	Planned		
Asphalt vacuum tower, bbl. per day	1,200	Building	Mid '50	Koch Engineering Co.
Esso Standard Oil Co., Bayonne, N. J.:				
Dewaxing unit, bbl. per day	7,500	Building	Early '50	E. B. Badger & Sons Co.
Increase steam generating capacity, lb. per hr.	260,000	Building	Mid '50	Day and Zimmerman
Esso Standard Oil Co., Everett, Mass.:				
Pipe still, naphtha rerun, bbl. per day	7,000	Building	Late '50	
Increase steam generating capacity, lb. per hr.	210,000	Building	Late '50	
Esso Standard Oil Co., Baton Rouge, La.:				
Office and cafeteria buildings		Building	Mid '50	John W. Harris Associates, Inc., Bodman & Murrell
Excelsior Refineries, Lloydminster, Alta., Canada:				
Capacity increase, bbl. per day	1,500	Building		
Freeport Sulphur Co., Westville, N. J.:				
Sulfur-recovery plant, tons per day	40	Building	1950	Girdler Corp.
Frontier Refining Co., Cheyenne, Wyo.:				
Thermal cracking and coking, bbl. per day	3,500	Building	June '50	Refinery Engineering Co. and Universal Oil Products Co.
Coking unit, bbl. per day	2,400	Building	June '50	

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ACTIVE REFINERY-BUILDING PROJECTS (Continued)

Company, location and type of project—	Capacity rating	Status	Comp. schedule	Contractors
Gas & Oil Refineries, Ltd., Hartell, Alta., Canada:				
Increase thermal cracking capacity, bbl. per day	500	Building	Mar. '50	Process Construction Co., Inc., and Sparling Davis Co., Ltd.
General Petroleum Corp., Torrance, Calif.:				
Cat. cracker furnace expansion, bbl. per day	4,000	Authorized	1950	Lummus Co.
Coker unit expansion, bbl. per day	7,500	Building	1950	E. B. Badger & Sons, M. W. Kellogg Co.
Hydrogen sulfide absorber, tons per day	55	Building	1950	E. B. Badger & Sons, M. W. Kellogg Co.
Globe Oil & Refining Co., Lemont, Ill.:				
Catalytic cracking unit, bbl. per day	6,000	Building	Early '50	Universal Oil Products Co.
Graco Refining Co., Newcastle, Wyo.:				
Thermal cracking unit, bbl. per day	1,200	Building	Early '50	Koch Engineering Co.
Great Lakes Refining Division, Petco Corp., Blue Island, Ill.:				
Catalytic cracking unit, bbl. per day	5,000	Building	Mid '50	Catalytic Construction Co.
Hi-Way Refineries, Ltd., Saskatoon, Canada:				
Atmospheric distillation unit, bbl. per day	2,000	Building	1950	Universal Oil Products Co. and Refinery Engineering Co.
Thermal cracking unit, bbl. per day	600	Building	1950	Universal Oil Products Co. and Refinery Engineering Co.
Treating and gas recovery facilities		Building	1950	Universal Oil Products Co. and Refinery Engineering Co.
Imperial Oil, Ltd., Sarnia, Ont., Canada:				
L.P.G. plant, bbl. per day	800	Building	1950	
Imperial Oil Co., Ltd., Winnipeg, Ont., Canada:				
New refinery, bbl. per day	12,000	Authorized	Early '51	Canadian Kellogg Ltd.
Indiana Farm Bureau Co-op Association, Inc., Mount Vernon, Ind.:				
Cat. cracking unit, bbl. per day	5,000	Building	1951	Universal Oil Products Co.
Gas-concentration unit, bbl. per day	3,500	Building	1951	Universal Oil Products Co.
Vacuum unit, bbl. per day	300	Building	1951	Universal Oil Products Co.
Revamp polymerization unit				Universal Oil Products Co.
Lion Oil Co., El Dorado, Ark.:				
Naphtha rerun unit, bbl. per day	1,200	Building	Early '50	
Magnolia Petroleum Co., Beaumont, Tex.:				
Revamp cat. cracking units		Building	Late '50	
Mississippi Chemical Co., Yazoo City, Miss.:				
Chemical plant		Planned		
Monarch Refineries, Inc., Oklahoma City:				
Vacuum lube unit		Considering		
National Co-op Refinery Association, McPherson, Kans.:				
Polymerization unit		Considering		
Oklahoma Refining Co., Seminole, Okla.:				
New refinery, bbl. per day	200	Building	1950	
Osceola Refining Co., Reed City, Mich.:				
Desalting unit		Authorized		
Pan-Am Southern Corp., El Dorado, Ark.:				
Delayed coker and facilities, bbl. per day	9,300	Building	Oct. '50	The Lummus Co.
Panhandle Producing & Refining Co., Wichita Falls, Tex.:				
Cat. cracking unit, bbl. per day	1,500	Building	Early '50	Jones & Laughlin Supply Co. and Universal Oil Prod. Co.
Phillips Chemical Co., Etter, Tex.:				
Increase chemical-plant capacity, tons per year	100,000	Authorized		
Phillips Oil Co., Kansas City, Kans.:				
Cat. cracking unit, bbl. per day	24,000	Building	Early '50	C. F. Braun & Co.
Producers Refinery, Inc., West Branch, Mich.:				
Refinery expansion, bbl. per day	1,500	Planned		
Pure Oil Co., Savannah, Ga.:				
Lube-oil processing plant		Authorized		
Salt Lake Refining Co., Salt Lake City:				
Cat. cracking unit, bbl. per day	10,000	Authorized	Late '50	Bechtel Corp.
Shallow Water Refining Co., Shallow Water, Kans.:				
Reforming unit, bbl. per day	1,250	Building	Early '50	Koch Engineering Co.
Shamrock Oil & Gas Corp., Sunray, Tex.:				
Cycloversion unit, bbl. per day	15,000	Building	Early '50	
Polymerization plant, bbl. per day	500	Building	Early '50	
Shell Oil Co. of Canada, Ltd., Montreal, Que., Canada:				
Poly. unit		Building	Early '50	
Cat. cracking unit		Building	Early '50	
Vacuum unit		Building	Early '50	
Treating unit		Building	Early '50	
Sioux Oil Co., Newcastle, Wyo.:				
Thermal cracking unit, bbl. per day	1,000	Building	Mid '50	Koch Engineering Co.
Catalytic polymerization		Building	Mid '50	Koch Engineering Co.
Skelly Oil Co., El Dorado, Kans.:				
Increase refinery capacity		Building	Mid '50	M. W. Kellogg Co.
Socony-Vacuum Oil Co., Inc., Trenton, Mich.:				
Revamp cat. cracking unit, bbl. per day	15,000	Authorized	1950	
Socony-Vacuum Oil Co., Augusta, Kans.:				
Revamp. cat. cracking unit, bbl. per day	15,000	Authorized	1950	Bechtel Corp.
Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.:				
Dewaxing unit, bbl. per day	2,500	Building	Early '50	E. B. Badger & Sons Co.
Light-oil treating, bbl. per day	28,000	Building	1950	
Propane deasphalting, bbl. per day	5,950	Building	1950	
Dewaxing unit, bbl. per day	2,050	Building	1950	
Modernize compounding and packaging, bbl. per day	5,000	Building	1950	
Socony-Vacuum Oil Co., Inc., East St. Louis, Ill.:				
Thermal cracking, bbl. per day	13,200	Building	1950	
Delayed coking unit, bbl. per day	8,000	Building	1950	
Misc. refinery additions		Building	1950	
Socony-Vacuum Oil Co., Inc., Casper, Wyo.:				
Topping unit revisions, bbl. per day	5,000	Building	1950	

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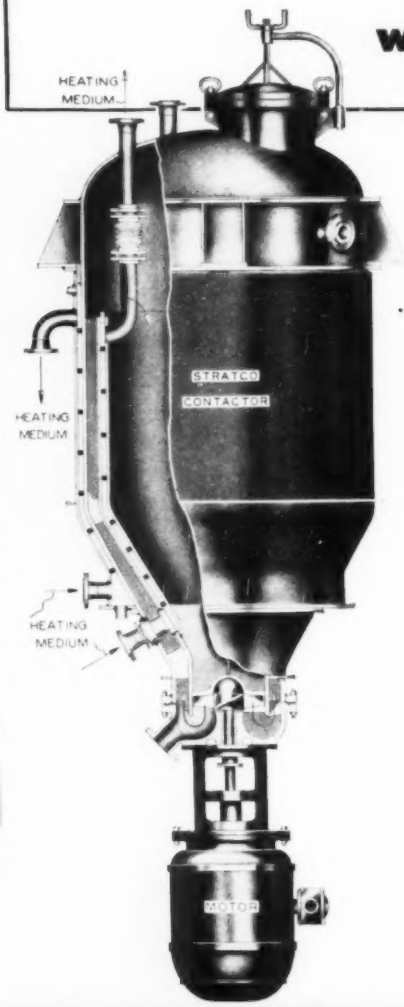

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ACTIVE REFINERY BUILDING PROJECTS (Continued)

Company, location and type of project	Capacity rating	Status	Comp. schedule	Contractors
Stancal Asphalt & Bitumuls Co., Point Wells, Wash.:				
Asphalt plant		Authorized		
Standard Oil Co. of California, Coalinga, Calif.:				
Distillation equipment		Building	Early '50	
Stanolind Oil & Gas Co., Brownsville, Tex.:				
Chemicals recovery and refining		Building	Early '50	E. B. Badger & Sons Co.
Sun Oil Co., Toledo:				
Cat. cracking unit, bbl. per day	30,000	Building	Early '50	Catalytic Const. Co., Fluor Corp., Process Engineers, Inc., Sun Oil Co.
Crude unit, bbl. per day	30,000	Building	Early '50	Catalytic Const. Co., Fluor Corp., Process Engineers, Inc., Sun Oil Co.
Sun Oil Co., Marcus Hook, Pa.:				
Crude topping and catalytic units, bbl. per day	30,000	Building	Apr. '50	W. W. Lindsay Co. and Sun Oil Co.
The Texas Co., Lawrenceville, Ill.:				
Increase refinery capacity, bbl. per day	20,000	Authorized	Early '51	Foster Wheeler Corp. and M. W. Kellogg Co.
Tide Water Associated Oil Co., Drumright, Okla.:				
Catalytic cracking unit, bbl. per day	4,500	Building	Early '50	Process Engrs., Inc.
Trinidad Leaseholds (Canada), Ltd., Port Credit, Canada:				
Treating plant		Planned		
Uinta Oil Refining Co., Jensen, Utah:				
Debutanizer, bbl. per day	850	Building	Apr. '50	
Union Oil Co. of California, Oleum, Calif.:				
Revisions to crude facilities		Building	Early '50	R. M. Parsons Co., Ehrhart & Arthur, Inc., and Refinery Maintenance Co.
Improvements to compound and barrel handling facilities		Building	Early '50	J. M. Montgomery & Co., Fred J. Early Co. and C. Norman Peterson
Additions to main office and other buildings		Building	Early '50	Austin Field & Fry, Don R. Warren Co., J. M. Montgomery & Co., E. S. McKittrick and Parker, Steffens & Pearce
Fuel oil tankage and transfer facilities		Building	Mar. '50	R. M. Parsons Co., Eaton & Smith, Utah Const. Co. and Chicago Bridge & Iron Co.
Vickers Petroleum Co., Inc., Potwin, Kans.:				
Revamp cat. poly. plant, bbl. per day	250	Building	Early '50	
Reforming unit, bbl. per day	1,000	Building	Early '50	
Desalting unit, bbl. per day	6,000	Building	Early '50	

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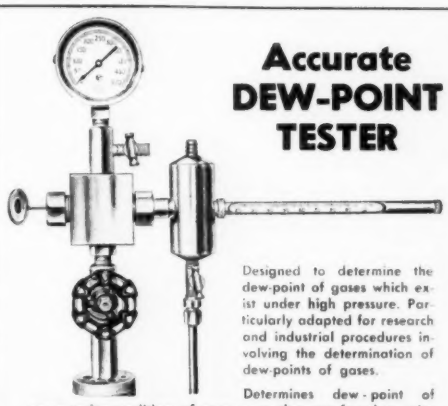

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TABLE 3 FURFURAL REFINING GAS OILS SULFUR REMOVAL

	Virgin stocks				Cracked stocks				
	West Texas		Poza Rica		Arabian		Mixed paraffinic and naphthenic		
Crude source	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate	Charge	Raffinate	Raffinate
Yield, volume per cent	100	69.0	100	92.4	100	78.9	100	70.0	50.0
Sulfur, weight per cent	1.31	0.68	0.97	0.58	1.39	0.39	0.833	0.51	0.137
Gravity, A.P.I.	27.0	33.0	36.4	39.4	32.0	40.5	24.0	29.9	37.0
Color, N.P.A.									
Cetane No.	52.5	69.5	59	66	44.8	62.5	30.7	42.4	57.4
Distillation, A.S.T.M.									
I.b.p., °F.	480	522	466	472	444	455	468	416	474
10 per cent	576	596	515	522	478	481	500	496	506
50 per cent	668	698	560	562	524	526	536	536	546
90 per cent	735	760	619	620	600	605	596	600	604
End point					634	636	634	626	634

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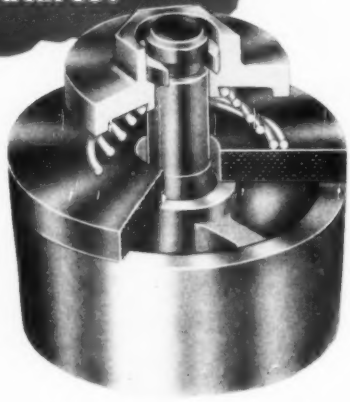

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2. Phenolic valve plate is highly resistant to both chemical action and high temperatures.
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Furfural Refines Gas Oil

(Continued from page 213)

manufacture of wood preservatives, vegetation killers, and for other purposes.

Sulfur Removal

The presence of sulfur in appreciable quantities in the fuel is considered objectionable from the standpoint of engine wear and fouling in operation of high-speed diesel engines. Thus the processing of high-sulfur crudes presents, in most cases, the problem of removal of the sulfur constituents from gas oil to be used in the manufacture of satisfactory fuels. Furfural selectively dissolves most of these sulfur constituents and its use as a solvent in the extraction of gas oils effectively reduces the concentration of these undesirable components. Table 3 shows the effect of furfural treatment on several virgin gas oils and catalytically cracked cycle stocks.

While the nature of the sulfur compounds present in the gas oils from various crudes may differ, the data presented in both Table 3 and Table 1 show that the crude source from which the charge stocks are derived does not materially influence the effectiveness of furfural as a selective solvent for removal of sulfur compounds.

Improvement in Burning Qualities

The cycle gas oil from catalytic cracking operations may be furfural refined to produce a furnace oil that is entirely suitable for use in all types of domestic heating equipment. The tests in Table 4 gives a comparison between refined and unrefined catalytic cycle gas oil and a virgin reference fuel as measured by the better-known quality indices.

Since the pot-type burner requires fuel of highest quality for satisfactory service, the unrefined and refined cracked fuels were tested in a burner of this type. The results from the investigation reveal that a large amount of excess air is necessary to burn the unrefined catalytic cycle gas

oil without smoking. However, the unrefined oil is totally unsatisfactory in this equipment due to the large amount of carbonaceous material deposited on the inside of the pot.

The comparative amounts of burner deposits, accumulated in a 7-day cyclic operation under typical domestic conditions in which 205 lb. each of the unrefined and furfural-refined catalytic cycle gas oil were burned with no smoke, are shown in Fig. 2. These deposits amounted respectively to 52.6 and 3.7 g. The quantity of deposit from the refined stock was essentially the same as that obtained with the virgin reference fuel burned under the same conditions.

Improvement of Catalytic Cracking Feed Stocks

Furfural refining will bring about substantial removal of nitrogen compounds and thus increase the value of these stocks for catalytic cracking feed. For example, refining the California virgin gas oil, shown in Table 1, to a 95 per cent raffinate yield results in a reduction of the nitrogen bodies from 0.15 to 0.05 weight per cent. It is generally known that the presence of nitrogen compounds in stocks charged to a catalytic cracking operation increases the amount of carbon laydown on the catalyst in proportion to the nitrogen content. Where coke burning is a limiting factor, the removal of nitrogen compounds is particularly effective in increasing the charge rate to and production from a catalytic cracking unit.

The unrefined and refined California gas oils were evaluated in a fluid catalytic cracking pilot unit. A comparison between the two particular runs reveals that the cracking susceptibility is materially increased by furfural refining. For the refined stock, the coke yield is 25 per cent less and the total dry gas produced also is substantially less. The yield (charge basis) of C_5 to 420° F. end point naphtha is 1 per cent higher, the butane yield (basis total butanes) is 6 per cent higher, and the leaded octanes of the gasoline are 2 to 2.5 points higher in the case of the furfural refined charge.

The presence of metal contaminants such as iron, vanadium, nickel, and chromium, even in small amounts, in catalytic cracking feed stocks is also harmful with respect to catalyst activity, since they build up on the catalyst. Their removal reduces carbon laydown and lowers the hydrogen factor. Furfural refining of virgin stocks not only removes the major portion of the compounds containing sulfur and nitrogen, but also lowers the concentration of metals. For example, in the case of a virgin California gas oil, the metal contaminants iron, vanadium and nickel were reduced about 70 to 80 per cent by furfural refining.

The value of furfural refining cycle

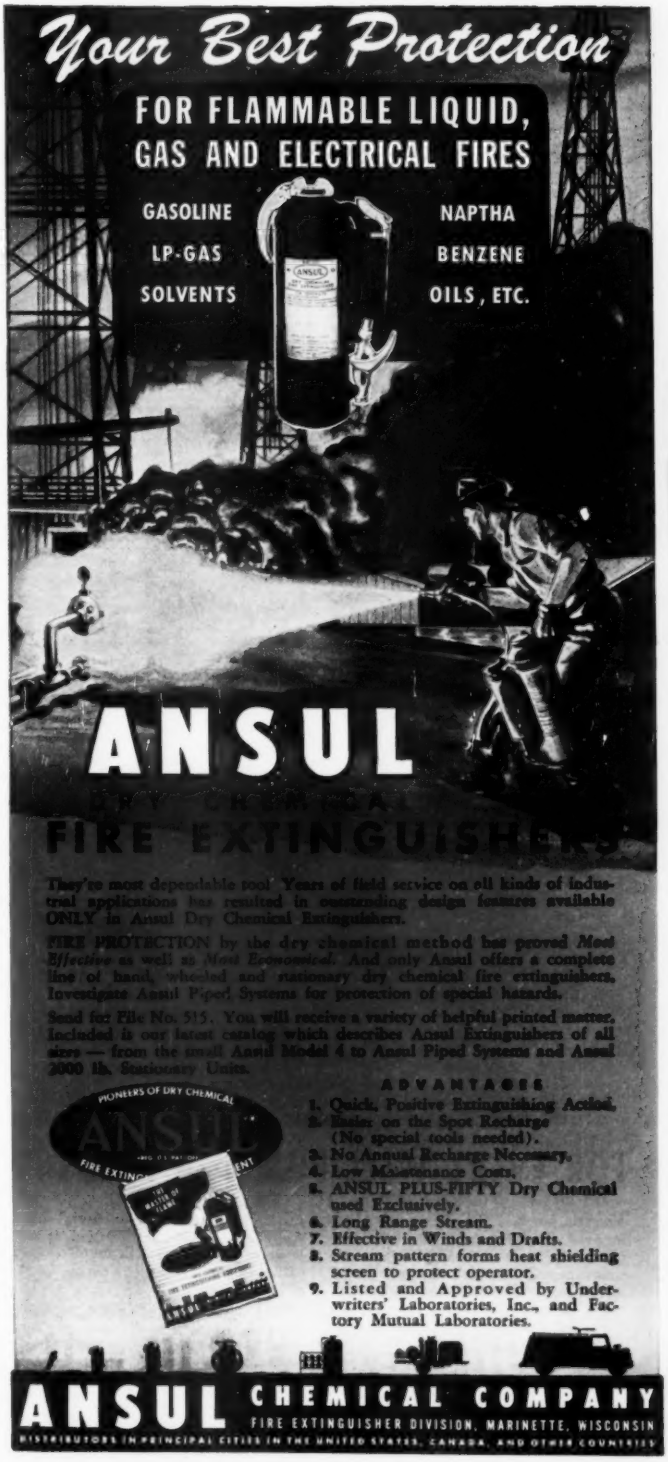
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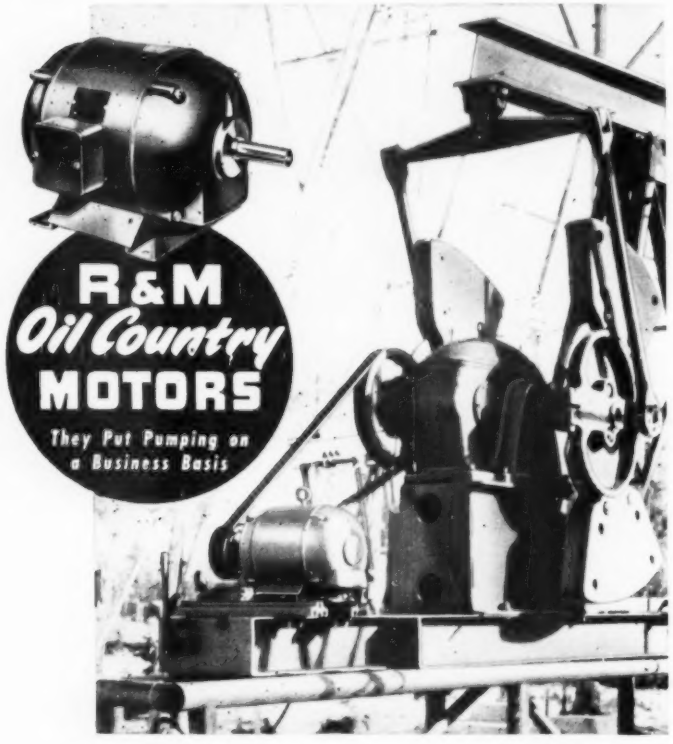
TABLE 4—BURNING OIL CHARACTERISTICS

Burning oil—	Catalytic cycle gas oil	Furfural refined catalytic cycle gas oil	Virgin reference fuel
Gravity, °A.P.I.	29.7	39.0	39.3
Burning index (Atlantic method)	53	84	83
B.t.u. per pound	19,400	19,700	19,750
Carbon-hydrogen ratio	7.20	6.26	5.53
Diesel index	38.1	67.0	65.6
Cetane number	39.5	57.7	55.8
Aniline point, °F.	128.7	171.9	167.0
Sulfur, per cent	0.48	0.04	0.05
Distillation, A.S.T.M.:			
I.b.p., °F.	446	442	378
10 per cent	475	467	432
50 per cent	514	510	512
90 per cent	590	592	584
End point	644	638	630



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gas oils for charge stock to catalytic cracking operations is shown by the comparative results obtained in the cracking of a virgin gas oil and a furfural refined light catalytic cycle gas oil derived from the same crude source in a commercial installation. The physical characteristics of the two charge stocks were as follows:

	Virgin gas oil	Furfural refined catalytic cycle gas oil
Gravity, °A.P.I.	30.5	34.8
Aniline point, °F.	141.8	147.2
Distillation, A.S.T.M.:		
10 per cent, °F.	452	460
50 per cent, °F.	545	502
90 per cent, °F.	710	580

The results presented in Table 5 show that the yield of products from the refined cycle gas oil and virgin stocks is comparable, while the quality of the gasolines from the refined cycle stock is higher. These comparisons clearly demonstrate furfural refining can be employed to upgrade the quality of cycle gas oils to that of or better than virgin gas oil as charge stock to a catalytic cracking unit.

TABLE 5—YIELD QUALITY COMPARISON F.C.C. OF VIRGIN GAS OIL AND FURFURAL REFINED CYCLE STOCK

	Virgin gas oil	Furfural refined catalytic cycle gas oil
Charge stock:		
Yields:		
C_5+ naphtha, vol. %	33.8	33.8
C_5+ naphtha, vol. %	26.0	23.4
Coke, wt. %	8.94	8.98
Quality:		
Light naphtha		
Gravity, °A.P.I.	73.5	75.4
90% point, °F.	180	184
C.F.R.M. octane	79.8	82.4
Bromine No.	146.5	122.1
300-430 naphtha		
Gravity, °A.P.I.	39.5	35.9
C.F.R.M. octane	76.2	81.1
Bromine No.	43.6	24.1
Over-all naphtha		
Octane:		
C.F.R.M. clear	77.9	81.6
C.F.R.M. +3 cc TEL	80.9	84.5

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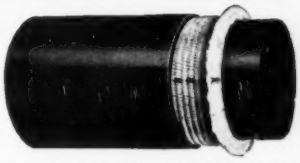

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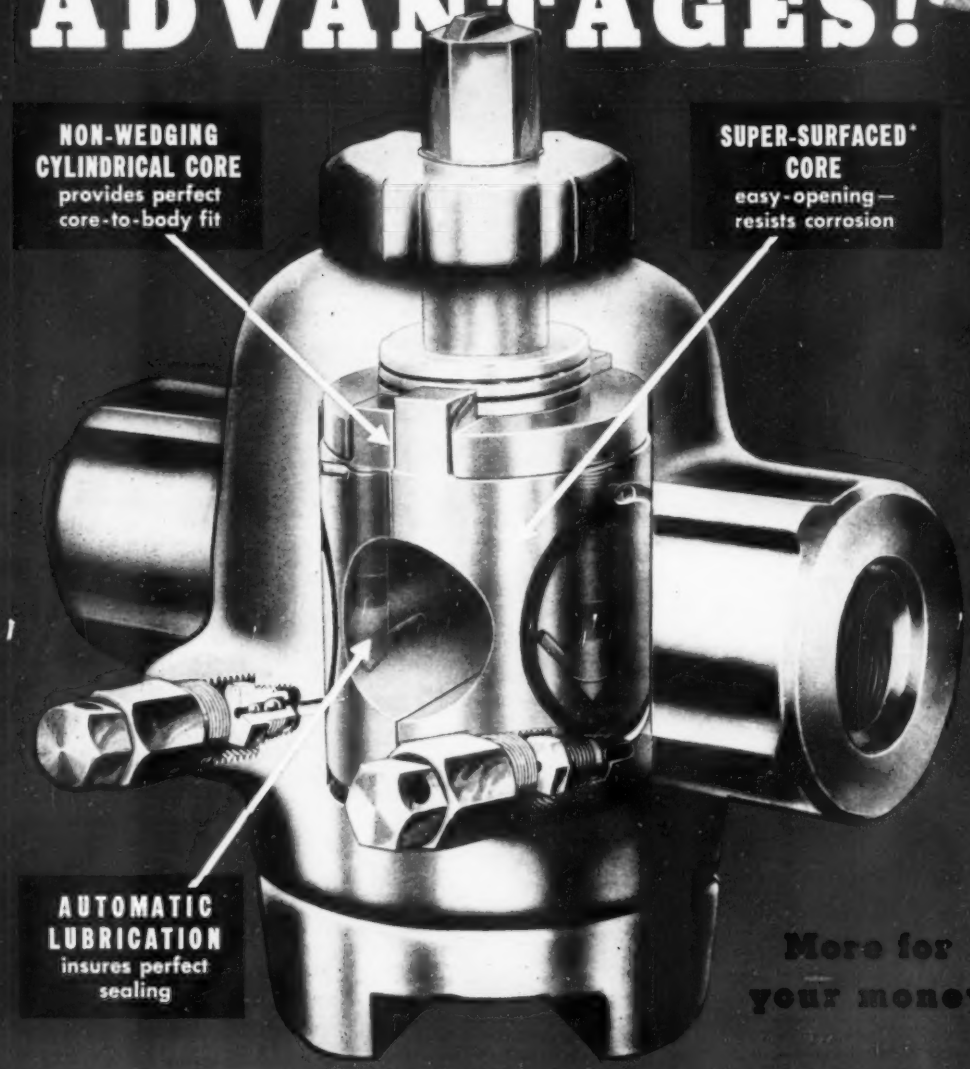

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Evaluation of Factors Affecting the

LAYOUT OF REFINING UNITS

by L. Ross*

SOHIO has recently completed an extensive program for the construction of major refining facilities at the No. 1, Lima, and Toledo refineries *(see The Oil and Gas Journal, January 12, 1950)*. Since these installations cost in the neighborhood of $50,000,000, in the initial planning it was apparent that a tremendous amount of maintenance, operations, and engineering would be involved. This article describes some of the aspects affecting the layout of refining units, such as in the Lima-Toledo refinery program, and others.

In order for a refinery "layout" program to gain success, the engineering work must achieve four objectives. These are:

1. To meet product quality and quantity requirements.
2. To erect units which afford the maximum safety protection to the operating and maintenance personnel.
3. To build the most economical units.
4. To construct units so that maintenance and operating costs will be at a minimum.

A factor which governs the successful achievement of the engineering objectives is the actual physical layout of these units. The purpose, therefore, of this paper is two-fold:

1. To discuss the factors affecting the layout of refining units.
2. To present a method of evaluating these factors.

Factors Affecting Location of Units Within Refinery

In order to discuss the factors relating to the layout of a refining unit, it is felt that the first consideration should include the location of the unit within the property limits of the refinery. The following major divisions will be used to analyze these factors:

1. Safety to operating and maintenance personnel.
2. Construction.
3. Operation.
4. Maintenance.

In the petroleum industry, almost every manufacturing or refining process is a potentially hazardous one. Because of this, the first point of importance is the safety to operating and maintenance personnel. To a great extent, the degree of safety of a unit is determined by its actual location in the refinery.

It is generally recognized as good design practice to study climatic conditions in analyzing the various factors in the location of units. It is essential that any piece of equipment which operates with open flame, such as a heater, be located so that there is no danger of explosive gases being carried by prevailing winds toward an open flame. Further consideration should be given to the proximity of a new unit to other plants in relation to prevailing winds for the same reason. Insofar as cooling towers are concerned, their drift losses of fine water spray must not be carried by prevailing winds toward operating platforms and walkways. If this condition exists, it is usually further aggravated by the formation of ice during winter weather. Naturally, this makes working conditions hazardous.

The relationship of a new unit to buildings housing mobile fire-fighting equipment is important. This distance should be minimized so that fire trucks can easily reach a fire in the shortest possible time.

Units which refine volatile products such as gasoline and naphtha usually employ blowdown or burning pot systems. These systems are used as a means of either removing products from the unit in case of an emergency or as a way of disposing of excess gas. The location of a new unit should be selected very carefully so that it is not adjacent to any type of an existing blowdown system.

The overcrowding of units always presents a potential hazard since a fire in one easily spreads to the others. This condition should be avoided. For example, during the construction of No. 1 refinery's cat cracker unit, a large fractionating tower was dropped by the contractor. Fortunately, this vessel did not harm any of the operating or construction personnel. However, had the No. 1 refinery's existing gas plant been nearer to the new construction site, this accident would have caused a great deal of damage.

These safety items discussed previously are by no means the only ones which should be considered in the layout of a refining unit. However, they are of prime importance, namely:

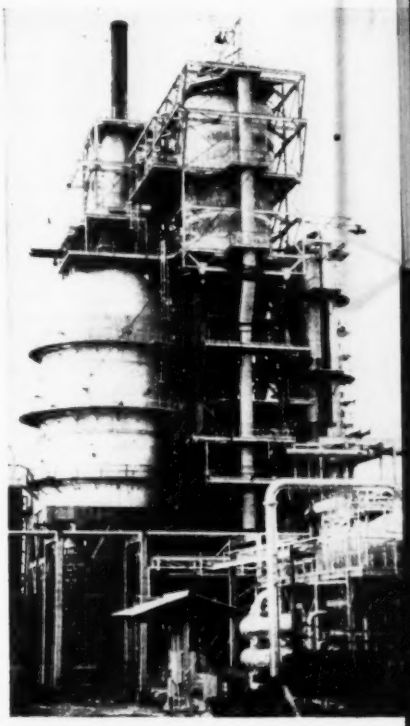
1. Effect of prevailing winds on general location.
2. Proximity to fire-fighting facilities.
3. Proximity to other units.
4. Distance from blowdown facilities.

In view of the fact that large construction work is usually handled by contractors, it is important that a site be provided on which the contractor can best perform his work in an efficient and expeditious manner.

In general, the contractor is responsible for the handling of all tools, machinery, material, and labor. If truck and railroad facilities are located near the construction site, his work can be executed at a lower cost.

During the construction of new units, the contractor may have as many as 500 workmen on the job site at the same time. It is advantageous to have his work site situated in such a manner that construction workmen travel a minimum distance from the plant entrance to the job site. This not only increases the efficiency of the contractor's men, but it also prevents them from disturbing other parts of the refinery which are operating.

If a contractor is building two or more units simultaneously, it is necessary to take into consideration the



One of the catalytic cracking units operated by Sohio.

*Standard Oil Co. (Ohio), Cleveland

common utilization of supervisory personnel. This can be accomplished by locating new units in the same general area. Naturally, care should be exercised in observing other layout factors before any final decision is reached.

During most refinery expansion programs, the construction of the refining units themselves usually overshadows the building of the necessary plant tie-ins and tankage. However, it is important to observe that the outside unit work usually consists of from 25 to 35 per cent of the total cost of the unit. Because of the large amount of money invested in these auxiliaries, it is essential that the unit be located as close as practicable to electric, steam, water, fuel gas, and fuel-oil facilities. Further, new storage and working tanks should be so located that the amount of piping is reduced as much as possible.

The modern refining unit usually consists of large towers, compressors, and structures which require massive foundations. Since excavation for these foundations plays a large part in the total cost of the unit, it is necessary that a site be selected where suitable soil conditions exist.

Before the site of a new unit has been selected, consideration should be given to its location relative to other existing operating units. This is important since the operation of an existing unit should in no way be disturbed by the construction of new ones. The building of new facilities usually requires welding, burning, riveting, and chipping. These are potential hazards which exist if the new unit is located too near an operating plant. Furthermore, with the employment of construction workers who are not familiar with refining methods and activities, the building of a new unit adjacent to existing facilities may in some way jeopardize its safety and operation.

To utilize refining property to the best advantage, all new units should be laid out so that they meet all established refinery layout policies; yet not to the point where an unnecessary amount of property is required. In order to be consistent, certain conformance should be made to layouts of existing plants. This should include the location of towers, buildings, exchangers, heaters, and stacks in line with the same type of existing equipment. By following this practice, the appearance of the unit and refinery will be improved and usually lower maintenance costs will result. Even though an economy of land should be considered, provisions should be made for sufficient ground area for the future expansion of a new unit.

The following major construction factors should be considered in selecting a site for a new unit:

1. Field handling of construction equipment.
2. Ease of access of construction personnel.
3. Construction supervision.
4. Soil conditions.
5. Accessibility of materials.
6. Proximity of tankage and utilities.
7. Proximity of new construction to existing units.
8. Conformance with general refinery layout.
9. Utilization of refinery space.
10. Future expansion.

The petroleum industry has an enviable reputation in promoting keen competition and rivalry among its companies. Its goal has always been to produce better products at lower costs. Because of this past record and other economic reasons, every refiner endeavors to operate his units as efficiently and economically as possible. Since good operation is a keynote in the refinery, it is necessary to consider this in preparing layouts of new units within the plant.

In order to reduce operating costs, consideration should be given to the possibility of integrating the supervision and operation of similar units. This type of operation can be accomplished by the selection of new areas either near or adjacent to existing plants. If two or more installations are to be built simultaneously, consideration should be given to the utilization of common control operations.

In locating the new unit with respect to tankage and utility facilities, it is essential that they be as near to each other as possible in order to decrease utility costs; yet not too close together to produce an unsafe condition.

For a unit to produce high-quality products, it is essential that an adequate production control program be initiated and maintained. This requires the execution of qualitative and quantitative tests in the control laboratory. In locating the new unit, thought should be given to the distance from the unit to such a control laboratory. Too great a distance might materially affect the cost and effectiveness of the control and testing operation.

After products have been finished, it is necessary to move them to truck or railroad shipping facilities. Here again, as in the case of tankage, it is essential that loading racks be located so as to minimize pumping costs.

Those conditions which will reduce the operational cost of a refining unit are:

1. Integration of existing units.
2. Pumping costs.
3. Proximity of rundown tankage.
4. Proximity of control laboratory.
5. Proximity of loading and shipping facilities.

It is interesting to observe that annual unit repair, maintenance, and turnaround costs average from 2 to 5 per cent of the total capital cost of a refining unit. Because of today's high material and labor costs, it is essential that this type of work be done as efficiently and as rapidly as possible. Since the distance from mechanical shops and warehouses to units affects the efficiency of maintenance and repair operations, it should be made as short as practicable. In some cases where this is not possible, new units should be accessible to well-paved refinery roads in order to speed the transportation of mechanical personnel, material, and equipment to the refining unit.

An advantage in locating a new unit adjacent to an existing one is that in some cases the maintenance for the two units can be carried on at the same time. Of course, the actual location of the new unit is based on many considerations. However, this factor is one which should be kept in mind.

Maintenance of a new unit can be improved by consideration of these features:

1. Proximity of mechanical shops.
2. Proximity of store house.
3. Proximity of roads and railroad tracks.
4. Possible integration with other units.

In the past, refining units were constructed with the thought in mind that their useful life may average from 15 to 25 years or longer. Because of present-day technological advances in the industry, new processes supersede old ones more rapidly and thus render units obsolete at an earlier age. The general trend, therefore, is toward a shorter unit life. This point should be kept in mind in locating new plants within the refinery. Careful consideration should be given to future addition of new units so that the refinery development can be made in an orderly fashion.

To summarize the factors affecting the location of units within the refinery, it is necessary to analyze factors which affect safety to operating and maintenance personnel, construction, operation, and maintenance.

Factors Affecting Location of Equipment and Buildings

Thus far this discussion has emphasized the important factors affecting the location of an entire unit within a refinery. This consideration is naturally first and foremost in the mind of the designing engineer. The next step is that of interior layout. Once more the four major objectives are applicable.

1. The interior layout of the unit must be safe for operating and maintenance personnel.
2. The layout must be arranged so that construction costs will be minimized.
3. There must be a functional layout—entirely practical from an operational standpoint.
4. Buildings, equipment, and structures must be situated so that maintenance work can be easily accomplished.

Of these four factors, safety is the most important. The main considera-

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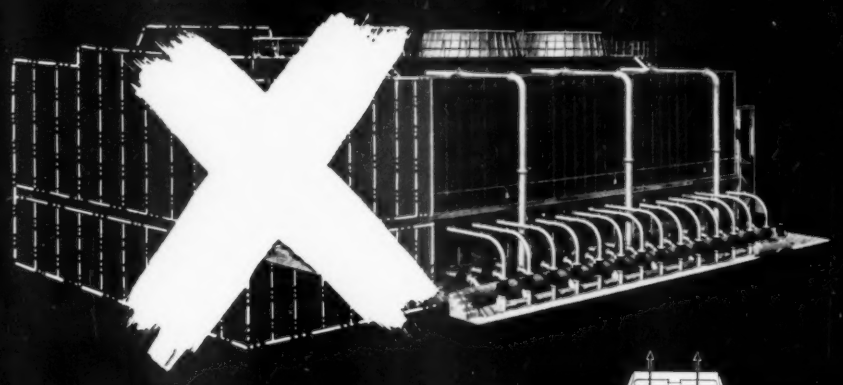

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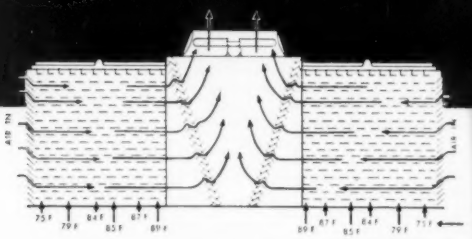

Typical water temperatures in a Double-Flow tower just before water enters the cold water basin. Temperature of water in cold water basin is 86 F.

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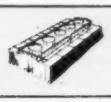
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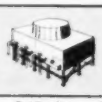
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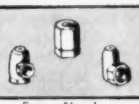
Spray Nozzles

tion in the construction and operation of all refining units is personnel and public safety. Accidents can be prevented by operating personnel; however, a great part of this responsibility is shared by the designing engineer. It is his job to provide a safe unit before all else. The layout of buildings, structures, and equipment is of the utmost importance.

The control room is the nerve center of the unit and should be centrally located. However, it should not be placed in a confined area where an exit would be difficult and dangerous in time of emergency. Furthermore, the control room should be kept apart from any equipment which is regarded as inherently dangerous.

The positions of towers are generally determined from a process standpoint. There are, however, some very important safety considerations which must be kept in mind when the unit is laid out. Platforms and walkways surrounding the towers will be frequently used by personnel for operational and maintenance purposes. For this reason, the avenues of escape should be free and clear with no possibility of obstruction. Stairways, ladders, and other means of escape should be situated at a safe distance from potentially hazardous equipment.

The location of pumps and compressors within a unit requires careful study. Since this equipment is subject to leakage, especially when fluids and gases are handled at high temperatures and pressures, there is always a chance that the surrounding atmosphere may at some time be contaminated. For this reason, such equipment must be situated a safe distance from heaters and on the downwind side of the unit, assuming a definite prevailing wind direction. If a building is constructed to house pumps or compressors, such a structure should be isolated from the control room in a separate building.

Another factor is the hazard created by certain drivers. For example, an internal-combustion engine presents hazards not encountered when steam power or electric motors are used. It is natural, therefore, that such pump and compressor installations be situated a safe distance from other elements of the unit.

The placement of fired heaters within a unit is particularly important since such equipment constitutes the greatest hazard. The heater should be located in an open area with a greater amount of free space around it than would be necessary for other items of equipment. This will reduce the danger of a "flash back" since air will circulate freely around the heater and prevent the concentration of light ends in explosive proportions. Furthermore, there will be adequate access to and from the heater in case of fire.

The proper location of heat exchangers can materially affect the safety of operational personnel, although the problem is not as serious as in the case of fired heaters. Whenever possible, exchangers should be installed near grade level, preferably no more than two high. This type of installation will reduce hazards to personnel, especially during tube-bundle removal operations.

Transportation facilities adjacent to or within the unit will greatly influence its equipment layout. For example, plants manufacturing light products should be well removed from railroad tracks. Sparks from a switch engine could do enormous damage. In addition, the main roadway through the refinery should not be used as a bundle-removing area for a group of exchangers. Access paths and vehicular driveways within battery limits should be routed to avoid dangerous constrictions. If at all possible, an alternate route should be provided.

Fire-protection facilities for units usually consist of deluge nozzles, steam blanketing systems, fire water hydrants, fixed foam installations, and various pieces of mobile equipment. In order that these can function properly in time of emergency, a well-planned unit layout is required. Hydrants and deluge nozzles should be placed in open areas well away from possible sources of fire and yet within effective range. Roads and driveways through the unit should be laid out to accommodate the largest piece of fire-fighting equipment; the overhead and side clearances as well as the turning radius should be considered.

In summarizing factors regarding safety, consideration should be given to:

1. Location of control room.
2. Location of towers.
3. Location of pumps and compressors.
4. Location of heaters.
5. Location of exchangers.
6. Location of fire protection facilities.
7. Prevailing wind direction.
8. Spacing of equipment and buildings.

The second prime objective in planning a refining unit is that of keeping construction costs to a minimum. This does not mean flimsy structures, a nonfunctional arrangement of equipment, or any cutback in quality below the level desired. Rather it means an efficient layout planned with an eye toward the grouping of like equipment, provisions for possible future expansion, and accessibility for construction personnel.

It is obvious that similar pieces of equipment should be grouped together wherever possible. The cost of foundations for a row of exchangers is far less than that involved for exchanger foundations scattered throughout the unit area. Material-handling costs are greatly reduced if the layout provides for the delivery of like equipment to one location instead of to three or four.

The unit should be planned in as functional a manner as possible. As piping accounts for a considerable share of the total unit cost, it is very important that equipment be located so as to obtain the best process conditions with the least amount of pipe. If this objective is attained, a compact unit layout will logically result.

Another method by which construction costs may be minimized is the utilization of common structures. Steel is expensive, whether it takes the form of pipe or I-beams. If the various parts of a refining unit can be arranged in a pattern which requires only one supporting structure instead of four or five, it naturally follows that costs will be reduced.

Material is not the only construction cost, however, since labor accounts for a large share of the total. If man-hours can be reduced by eliminating unnecessary movements of men, materials, and tools, considerable savings can be effected. It is therefore important that a unit layout take into account the accessibility factor, not only for the time when the unit is complete and on stream but for the construction period as well.

If future expansion of the unit is definitely contemplated, this fact should also be kept in mind when planning the layout. For example, adequate space should be provided for the installation of additional exchangers, or the pump room could be sized to accommodate future pumps. In general, equipment should be situated in such a way that construction costs for future expansion will be kept as low as possible. Much depends on how certain the future plans are and how many months or years will lapse before such a program is initiated. To invest large sums of money in oversized pump rooms which would not be completely utilized for 10 years would be an unsound use of capital funds. Nevertheless, future developments should be given fair consideration in the preparation of a unit layout.

The main factors affecting the layout of building and equipment within the refinery unit area in connection with construction are:

1. Grouping of similar equipment.
2. Functional layout of equipment.
3. Utilization of common structures.
4. Access for construction personnel.
5. Access for construction tools and equipment.
6. Compactness of layout.
7. Ease of pumping.
8. Future expansion.

The third major objective in designing a unit layout is to achieve the best possible operating conditions. The importance of functional design has already been discussed with reference to economy of construction. It also results in lower operating costs.

An important factor in the operation of a unit is the cost of pumping

fluids from one vessel to another. If equipment is grouped in a functional manner, pipe lines will be shorter, pump sizes will be smaller, and the power consumed will be minimized.

The control room can be considered as the base of operations. As such, it should be located as close as feasible to the areas which are most frequently visited by the operators. Individual valves, valve manifolds, outside switchgear and recorders and other points of control should be quickly and easily reached from the control room. Precaution should be taken, however, to insure against excessive vibration from nearby equipment as this condition would have an adverse effect on vital instrumentation.

The unit's operability is greatly enhanced by the grouping of similar equipment. This fact seems obvious enough when considering pump rooms. The principle applies equally well to towers. Travel between towers is made extremely easy if their close proximity to one another permits a common structure for access at the various manhole levels.

Operations may further be made more efficient by the proper arrangement of stairways, platforms, and walkways. It was mentioned previously that this was necessary in the interest of safety, but it is also important from an operational standpoint.

Good housekeeping plays a large part in not only the operation of a plant but also in making it a safe place in which to work. If units are laid out with neat arrangements of equipment, the plant personnel have a greater incentive to keep them clean.

In summarizing, the factors which affect operations are:

1. Location of equipment for efficient operation.
2. Proximity of control room to equipment.
3. Accessibility of control equipment.
4. Provision for stairways and walkways.
5. Grouping of similar equipment.

The fourth main objective is to lay out a unit which will permit maintenance work to be completed in the shortest possible time and with a minimum cost.

Again the desirability of adequate spacing within the units becomes apparent. Trucks, cranes, and special rigs must have access to the unit, and for this reason, the location of equipment is important.

Each type of equipment presents its own maintenance problem. In the case of pumps and motors, adequate space must be provided for their removal. Thus, a pump room should not be completely surrounded by other structures but should have at least one side which is unobstructed.

For heat exchangers, space for removing tube bundles is necessary and similarly, furnaces require an open area for tube withdrawal.

A further aspect in planning a unit from a maintenance standpoint is that of facilitating inspection work. The principles involved are much the same as for operations, where adequate walkways, platforms, and ladders must be included.

In order to perform maintenance work in the shortest possible time at the lowest cost, the following factors should be considered:

1. Adequate spacing of equipment for repair work.
2. Adequate spacing for repairing heat-exchanger equipment.
3. Adequate spacing for maintenance and removal of pumps.
4. Adequate roadways for trucks and construction equipment.
5. Adequate platforms and stairways for inspection.
6. Location of heaters to facilitate tube removal.

In summarizing, the general factors which should be kept in mind in locating equipment within the unit area deal with safety to operating and maintenance personnel, construction, operation, and maintenace.

Summary

In reviewing the factors affecting the layout of refining units as discussed in this paper, it might lead one to believe that the job of design is practically impossible. It should be definitely stressed that the design of a refining unit like any other complex piece of machinery, is a continuous series of compromises. If these compromises are carefully considered, weighed, and balanced, the engineering objectives will be achieved. Units will therefore be constructed to meet product requirements and to provide for the maximum degree of safety, economy, and efficiency.

Filtration of Refinery Emulsions

(Continued from page 215)

agitation in the filter tank. The knife edge advanced automatically into the precoat layer a predetermined depth for each revolution of the filter drum.

The filter rate was measured by determining the rate of rise of the liquid level in the filtrate receiver. Vacuum was maintained on the filter by means of a small two-stage steam jet exhausting to the atmosphere. Runs were made to determine the effect on filter rate of such variables as type of precoat medium, temperature, pressure drop, depth of knife cut, drum speed, and recycle of filtrate. Runs varied in length from 8 to 22 hours, depending on the conditions used.

Precoat filtration of a production ratio mixture of all refinery waste oils and emulsions produced at Baytown resulted in complete resolution of the emulsions, and essentially complete separation of the oil and water was effected on settling at 160° to 180° F. for 4 to 6 hours. The water which separated from the oil after filtration was clear. The average oil content of the water was 34 p.p.m. The sediment removed from the precoat layer by the knife edge contained 20 to 30 per cent of oil.

Filter rates obtained on the pilot filter unit varied widely when charging similar samples of various blends of refinery waste oils and emulsions. This variation in filter rates was thought to be due to the nonhomogeneous nature of the oils and emulsions and to the difficulty of obtaining samples of uniform characteristics. Aging of the slop-oil charge samples in storage appeared to have a detrimental effect on filterability.

Filter rates on mixtures prepared from fresh waste oil and emulsion samples were found to be higher than filter rates on similar mixtures prepared from the same samples after standing in storage for several days. It was observed in several instances that samples of filtrate which immediately after filtration contained practically no sediment would, on standing for 2 to 3 weeks in the laboratory, contain a considerable amount of heavy tarry residue. This material was thought to consist of solid or semisolid asphalt-like bodies which were precipitated from solution as the result of polymerization or oxidation reactions occurring in the oil. Also, this precipitated material appeared to be responsible for the precoat plugging encountered in the attempt to precoat the filter when using slop-oil filtrate as the slurry oil.

The behavior of the oil described above indicates that it would be advantageous to filter and rerun emulsified waste oils as soon as possible after their recovery, without prolonged storage either on separators or in tanks. An average filter rate of 5.38 gal. per hour per square foot of filter surface was obtained when filtering production ratio blends of all waste oils and emulsions produced in the refinery.

Operating conditions maintained on the experimental filter during most of the runs were as follows:

Precoat medium	Dicalite Speedplus or Hyflo Super-Cel
Temperature, F.	180
Drum speed, sec./rev.	120
Knife cut, in./rev.	0.0025
Vacuum, in. Hg.	22-25

Table shows the average improvements in quality resulting from filtration of production ratio mixtures of all refinery waste oils and emulsions on the pilot filter.

The maximum and minimum figures shown in this table illustrate the extreme variation in contamination of the waste oil mixtures used in this study.

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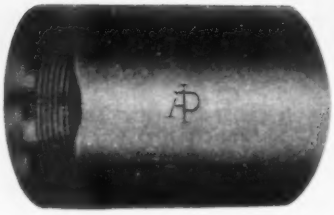

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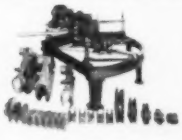

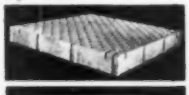

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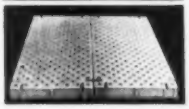

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size) of precoat materials were employed in the filtration studies to determine which would be most suitable for use in the filtration of refinery waste oils and emulsions. The results of these tests indicate that the medium-particle-size precoat materials were the most satisfactory with respect to filter rate and uniformity of operation. Such materials as Dicalite Speedplus (Dicalite Co.) and Hyflo Super-Cel (Johns-Manville) gave the best results. Coarser precoat materials were unsatisfactory because the finely divided solids in the emulsions penetrated the precoat cake to an appreciable depth, resulting in poor scraper cut and erratic filter rates.

Data obtained on the effect of temperature on filter rate of mixed slop oils are shown in Fig. 1. These data indicate that temperatures above approximately 180° F. had no appreciable effect on filter rate. The filter rates dropped rapidly, however, with temperature below 170° F. This unusual effect may be due in part to the high water content of the filter charge which results in vapor locking with water vapor in the precoat layer and filtrate piping. The vapor pressure of water at 180° to 190° F. approaches very closely the absolute pressure existing in the filter.

The results of runs made to determine the effect of drum speed on filter rates on Baytown waste oils and emulsions are shown in Fig. 2. Although higher filter rates can be obtained by increasing the drum speed, the precoat life is shortened considerably, being directly proportional to the drum speed when drum speed is expressed as time per revolution at a constant depth of knife cut.

The effect of depth of knife cut on filter rates is shown in Fig. 3. The curves in this figure illustrate very well the effect of penetration of the precoat by the finely divided solids in the oil. In runs 9, 16, and 17, relatively coarse precoat media were used, and the filter rates increased almost as a straight line function with increased depth of knife cut. In run 30 the relatively fine precoat used was penetrated to a much lesser degree.

The filter rate increased rapidly as the knife cut was increased from 0.0016 to 0.0025 in. per revolution; however, the increase in filter rate was much less rapid above a knife cut of 0.0025 in. per revolution. A knife cut of 0.0025 in. per revolution appeared to be the optimum for the pilot filter unit. Lower knife cuts caused considerable smearing of the precoat on passing under the knife, resulting in low filter rates. Higher knife cuts resulted in too rapid consumption of the precoat and shortened the precoat life excessively.

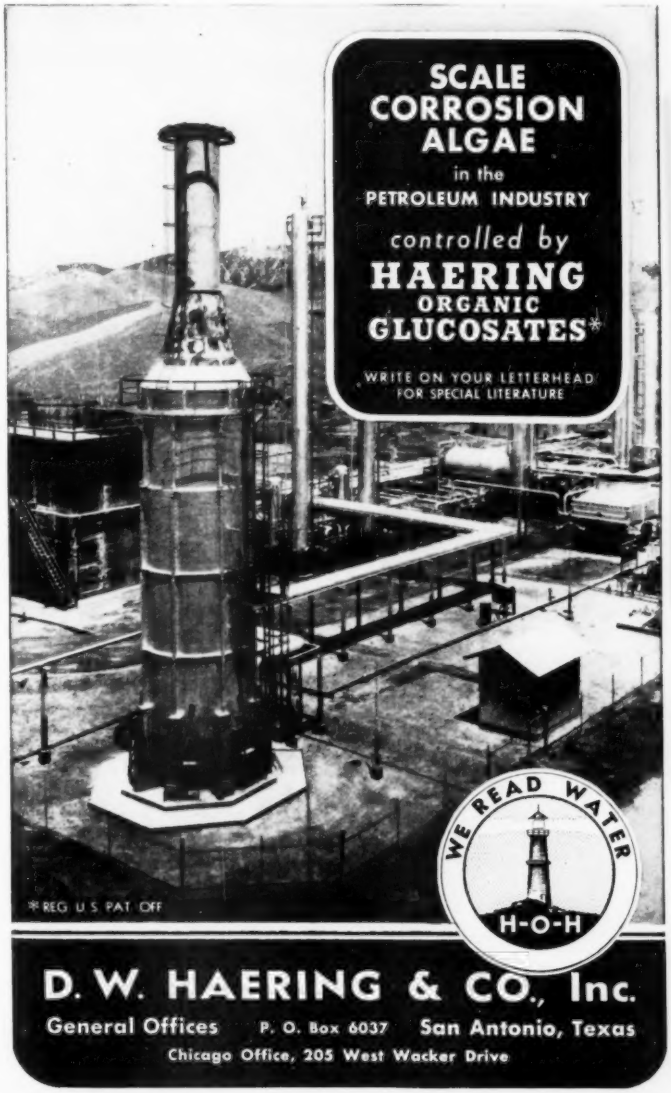
The results of test runs to determine the effect of pressure drop on filter rates of mixed emulsified oils are shown in Fig. 4. These results indicate that the filter cake deposited on the precoat is somewhat compressible since the rate of increase of filter rate becomes less as the pressure drop increases.

Filtration through a continuous precoat filter is a very effective means of resolving refinery emulsions of the water-in-oil type. The water content of the filtered oil is essentially zero. This process is also very effective in lowering the sediment

TABLE I—AVERAGE QUALITY IMPROVEMENT ON FILTRATION OF REFINERY EMULSIONS

	Sediment by extraction, %	Sediment by not filt.*, %	Water by dist., %	Water by total ash, %	Water Sol. ash, %
Charge:					
Maximum	1.544	1.510	28.8	0.840	0.320
Minimum	0.210	0.120	0.40	0.060	0.016
Average	0.563	0.638	9.22	0.440	0.090
Filtrate:					
Maximum	0.086	0.090	Zero	0.048	0.036
Minimum	Zero	Zero	Zero	0.002	Zero
Average	0.016	0.029	Zero	0.017	0.009
Average reduction, per cent	97.2	95.5	100	96.1	90.0

*Hulse, S. H., and Thwaites, H. L., Ind. & Eng. Chem., Anal. Ed. No. 10, p. 678, 1938.



and ash content of these types of refinery slop oils and emulsions.

Filtration is a more complete solution to the problem of recovering contaminated oils than chemical treatment because the water is obtained as a clear solution which may be discarded to the refinery effluent stream. Although the water layer of the filtrate contains a small amount of oil, the volume of this water would generally be so small in relation to the total refinery effluent stream, that this water would contribute a negligible quantity of oil to the effluent from the refinery.

The sediment is obtained in a relatively dry form which can be discarded in a manner similar to spent filter clays. Care should be taken to provide oil traps on surface drainage streams from the disposal area so that any oil washed out of the sediment may be prevented from leaving the plant. Another possible method of disposing of this sediment would be burning in a rotary type burner and using the oil-free sediment for fill.

Filtration of refinery waste oils and emulsions should result in considerable improvement in the operation of the gravity-type separators which receive the water-sediment layer and interfacial emulsion from chemical treating operations. The removal of these materials from the streams entering the separator would improve the quality of the separator effluent by reducing the amount of oil and solids lost with the effluent water.

Filtration of Separator Bottom Sediment

The filtration studies on separator bottom sludge were carried out on experimental equipment similar to that previously described for the slop-oil emulsion study.

Samples of sludge obtained from the bottom of the main separator containing from 0.3 to 14.4 weight per cent of dry sediment were filtered satisfactorily on the 2 by 12-in. vacuum precoat filter. Filter rates on these materials varied considerably, increasing with decreasing sediment content of the filter charge (see Fig. 5). Over-all sediment-removal rates increased with sediment content of the filter charge; however, the rate of increase of the sediment removal rate did not appear to be significant at sediment concentrations on the charge above about 5 per cent (see Fig. 6).

Sediment-removal rates varied from 1.0 to 1.4 lb. per hour per square foot of filter area when filtering a charge containing 2 per cent sediment. Sediment removal rates of 1.4 to 1.5 lb. per hour per square foot of filter area were obtained when filtering a charge containing 5 per cent sediment.

Dry filter cakes were removed from the knife-edge at sediment concentrations below 5 per cent on the filter charge. Sediment concentrations above 5 per cent resulted in the discharge of a wet, slushy cake from the filter. The sediment removed from the filter by the knife edge on 10 filtration runs in which the charge to the filter contained approximately 2 per cent sediment had the following average composition: dry sediment, 47.6 per cent; water 34.8 per cent; and oil, 17.6 per cent.

The average oil content of the total filtrate from five filtration runs in which the charge to the filter contained approximately 2 per cent sediment was 1.78 per cent by volume. The water in the filtrate from these runs had an average oil content of 37 p.p.m.

During this study several runs were made to determine the effect of various operating variables on the filtration of the separator sludge. The same types of precoat materials found to be effective for slop-oil emulsion filtration were also effective for dewatering the separator sediment. From a study of the results of these runs it appeared that the operating conditions listed previously for the emulsion filtration were also the optimum operating conditions for the plant scale filtration of the separate sediments.

The dry sediment removed from

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the filter was found to have a relatively high heating value (4,000 to 4,500 B.t.u. per pound). This suggests the possibility of burning this material in a rotary burner or some similar equipment, and using the oil-free sediment as fill.

Based on the results of this experimental study it has been concluded that vacuum precoat filtration is a practical means of dewatering separator bottom sediment. This process should eliminate the need for providing storage pits for the accumulation of separator dredgings.

Economics of Power Generation

(Continued from page 238)

either increases or decreases in the future.

To illustrate the above discussion graphically, these data have been combined and presented in Fig. 4 as a function of varying fuel-oil costs. A study of this plot will indicate the enormous magnitude of savings which can be realized from byproduct power generation. For example, at the present fuel oil price of around $2 per barrel, the out-of-pocket cost of power generation is $225,000 per year. In contrast to this, the cost of the same block of purchased power would have been $1,100,000 per year. The net savings would therefore be $875,000 annually. It will also be seen that the savings become smaller as the market fuel-oil prices increase. However, even at abnormally high fuel-oil prices there would still be substantial savings resulting from byproduct power generation.

The more important fact brought out by this graph is that the actual out-of-pocket expenditure of money for generated energy is small in comparison with the cost of the same amount of purchased power. During periods of depression or recession the actual number of dollars spent for energy is small and the refinery is then in a better position to meet competition.

The profits accruing from day-to-day operations are an excellent justification in themselves of the value of a byproduct power generating unit. But regardless of how great the profits, the more important question which must be answered is how quickly is the original investment for power generation amortized.

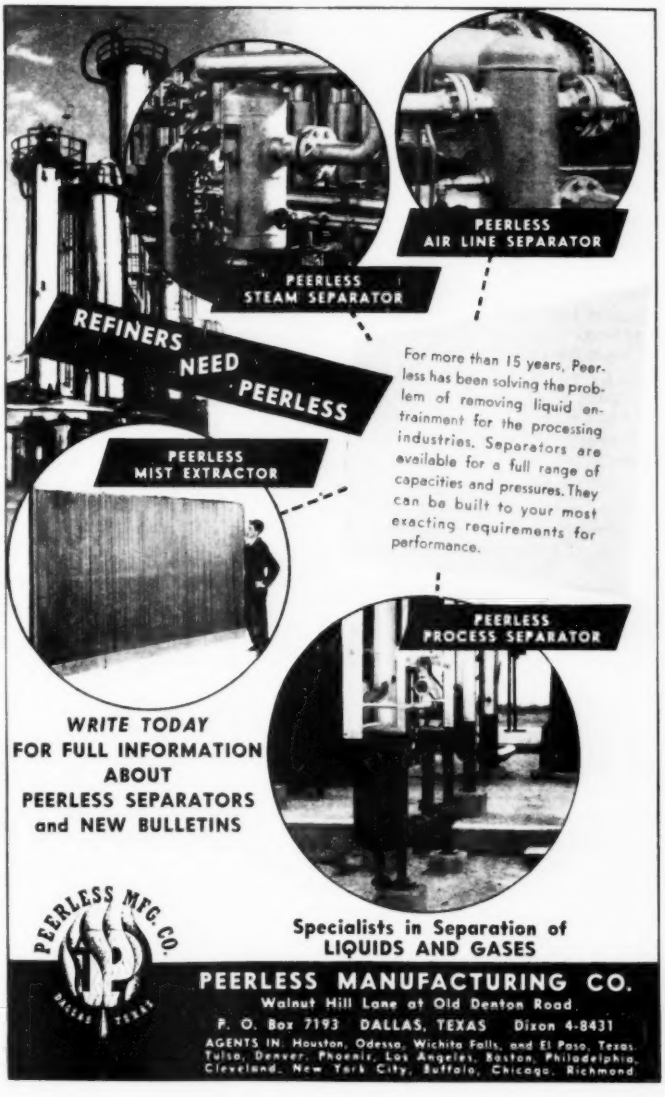
In order to answer this question, it is necessary to review the development of power-generation facilities in connection with the more completely integrated refinery. During 1947 and 1948 an extensive modernization program was initiated at the East Chicago refinery. This program included installation of a large fluid catalytic cracking unit, a polymerization unit, complete lube-oil-processing units, together with attendant cooling towers, etc. The new equipment required additional steam-generating capacity and it was decided to install three 900-psi. 900° F. 250,000-lb. per hour boilers. These steam conditions were selected to insure adequate electrical energy generation and at the same time insure ample reserve steam production. Had no power generation facilities been installed it would have only been necessary to build two 250,000-lb. per hour boilers at 600 psi. and 750° F. to operate the new equipment involved in the expansion program.

It is therefore apparent that the equipment directly chargeable to power generation would include (1) one additional high-pressure boiler, (2) the power-generating units and (3) the incremental cost of 900-psi. boilers over 600-psi. boilers. The total valuated cost of equipment incident to power generation amounts to approximately $4,300,000.

The savings which are attributable to power generation can be divided as follows:

1. Direct savings resulting from generated power over purchased power.

2. Fuel savings resulting from the operation of a single new 85 per cent efficiency boiler as against the oper-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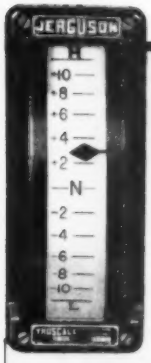

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The sum of the savings can then be used to pay out the cost of installation of the byproduct power station. These data are presented graphically in Fig. 5 as a function of varying fuel-oil price. This is a nearly flat curve since as fuel prices increase the savings resulting from generated over purchased power become smaller, while the fuel savings resulting from steam productions at high efficiency would become greater. Thus these two items tend to offset each other which results in a relatively constant pay-out period. This amortization period is such as to more than justify the original investment. For example, at present day fuel-oil prices of $2 per barrel, the pay-out period is about 4½ years.

In the final analysis, the entire utility installation at the East Chicago refinery is an excellent example of a modern highly efficient steam plant coupled with a power-generating station so as to produce large quantities of cheap byproduct power. A review of this discussion indicates that the equipment as installed adequately meets all of the requirements for a station of this nature. Among these requirements are such factors as:

1. Over-all flexibility in operation.
2. High-efficiency steam generation.
3. Cheap power production.
4. Sufficient reserve for future addition to both steam and power loads.
5. Economic steam and power production at all reasonably foreseeable conditions of plant operations.
6. Satisfactory return on original investment.

The East Chicago refinery power system, because of its dependability, flexibility, and economy under substantially all conditions of plant operations, is an important addition to the refinery. Cheap efficient byproduct power production will do much to guarantee lower-priced high-quality consumer products.

T.C.C. Unit Turnaround After 2 Years' Operation

(Continued from page 263)

sion. The chicken ladders have prevented onstream failures and little wear has appeared on the lines where they are present. The chicken ladders themselves have eroded or torn loose locally in a few places. Only on the lines from the kiln and reactor to the elevator have chicken ladders failed and required replacement. On these particular lines, new pipe in short sections has been installed so that chicken-ladder repairs and replacements may be easily made in the future.

Secondly, there are the 4-in. lines in intermittent service which do not have chicken ladders and often flow less than full. There have been numerous washouts, at and below elbows, on these lines. These lines may be patched while the unit is on stream; therefore the washouts are not serious.

Process lines.—Inspection of process lines was conducted by hammer testing, visual inspection, and by inspection instruments. All process piping has shown very good life with the exception of the hot-tar lines. This system, which operates at 750° F. and 20 psi. pressure, has shown a corrosion rate of 0.11 in. penetration per year with carbon-steel pipe. At the end of 2 years it was necessary to replace portions of this system. Plans are now in progress to replace this entire system with 4-6 per cent chrome, 0.5 per cent moly piping during the next turnaround. This alloy will resist the type of corrosion now being experienced.

After 2 years of operation, Lion Oil Co. finds that the Thermofor catalytic cracking unit installed at its El Dorado, Ark., refinery, presents no maintenance or operating problems that cannot be taken care of by existing engineering, operating, and mechanical departments.

BOOKS

A.S.T.M. STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS. Prepared by A.S.T.M. Committee D-2, and published by American Society for Testing Materials, 1916 Race Street, Philadelphia. 1422 pp. $5.50 paper binding, $6.15 cloth binding.

This publication brings together in convenient form the various A.S.T.M. standard and tentative methods of test and specifications pertaining to petroleum, and the regulations and personnel of Committee D-2 and its subcommittees and technical committees. Included also is information only on 10 proposed methods of test which are published in draft form for the purpose of soliciting comments. Such proposed methods have not been formally approved by the society and are distinguished from the standards and tentatives by the absence of an A.S.T.M. serial designation.

A.S.T.M. STANDARDS ON GASEOUS FUELS. Sponsored by A.S.T.M. Committee D-3 on Gaseous Fuels. Published by American Society for Testing Materials, 1916 Race Street, Philadelphia. 100 pp. $1.15.

This special compilation contains the three standardized tests developed by Committee D-3. They are (1) Calorific Value of Gaseous Fuels by the Water-Flow Calorimeter (D 900), (2) Specific Gravity of Gaseous Fuels (D 1070), and (3) Measurement of Gaseous Fuel Samples (D 1071).

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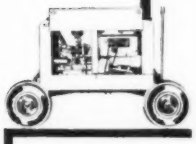

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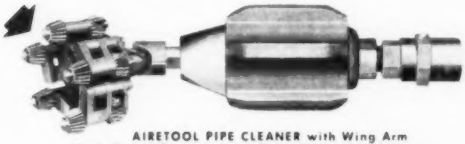

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QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

This department was created for the purpose of aiding managers, superintendents, engineers, chemists and all those engaged in various phases of plant operation, as well as those connected with the marketing and utilization of petroleum products. Readers are invited to submit their problems to W. L. Nelson, technical editor. Inquiries must be signed, but only the initials will be printed.

Character of Base of Crude Oils Or Their Products

(See "Character of Crude Oil," The Oil and Gas Journal, March 9, 1950, page 94.)

(**PARAFFIN** Characterization Factor above 12.05—**NAPHTHENE** base below 11.4)

Character factor B.P. of fract.	Gravity of fractions, °A.P.I. Key 0 235° F.	Key 1 504° F.	Key 2 755° F.	Correl. index Key 1 493° F.	Key 2 715° F.	V.G.C.* 700° F.	Aniline point, °C.* 400° F.	550° F.	Diesel index* 550° F.	Character. grav. 680° F.	Oct. No. of cr. gaso.*	Kerosine smoke pt.* 430° F.	Kauri butanol*	Viscosity index*	Carbon hydrogen ratio* 200° F.	500° F.	900° F.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
12.9	74.5	53.5	39.4		10.0												
12.8	73.3	52.0	38.3		13.0												
12.7	71.8	50.1	36.8		16.0									113			
12.6	70.1	49.2	35.5		19.0									110			
12.5	68.4	47.6	34.2	9.5	22.0	802	80.0	93.0					30	108	5.42	5.54	6.12
12.45	67.7	46.9	33.5	11.0	23.6	805	78.6	91.7							5.49	5.59	6.20
12.4	67.0	46.2	32.8	12.5	25.2	808	77.2	90.3	79				31	104	5.55	5.65	6.28
12.35	66.2	45.4	32.2	14.0	26.9	811	75.8	88.9	78						5.60	5.72	6.35
12.3	65.3	44.7	31.5	15.5	28.6	814	74.4	87.4	76				31	100	5.66	5.79	6.42
12.25	64.5	44.1	30.9	17.0	30.3	817	73.0	85.9	74			45			5.72	5.85	6.50
12.2	63.7	43.4	30.2	18.5	32.0	821	71.6	84.4	72			41	32	96	5.78	5.91	6.58
12.15	62.9	42.7	29.5	20.1	33.7	824	70.2	83.0	70			37			5.84	5.98	6.66
12.10	62.1	41.9	28.8	21.7	35.4	828	68.8	81.5	68			33	33	92	5.90	6.05	6.74
12.05	61.2	41.2	28.2	23.3	37.1	832	67.4	80.0	67			30			5.96	6.11	6.82
12.00	60.3	40.4	27.5	25.0	38.8	836	66.0	78.5	65	31.1	66.7	28	33	86	6.03	6.18	6.90
11.95	59.5	39.7	26.9	26.6	40.5	840	64.6	77.0	63	30.4	67.2	26			6.11	6.24	6.97
11.90	58.8	39.0	26.3	28.2	42.2	844	63.2	75.5	61	29.7	67.8	25	34	80	6.19	6.30	7.05
11.85	58.0	38.3	25.7	29.8	43.9	848	62.8	74.0	59	29.1	68.3	24			6.24	6.37	7.14
11.80	57.2	37.6	25.0	31.7	45.7	852	60.4	72.5	57	28.4	68.9	23	36	72	6.29	6.44	7.23
11.75	56.3	36.9	24.4	33.3	47.4	856	59.0	71.1	55	27.8	69.4	22			6.35	6.51	7.31
11.70	55.4	36.2	23.7	35.0	49.2	860	57.6	69.6	53	27.1	69.9	21	38	64	6.41	6.59	7.40
11.65	54.7	35.5	23.0	36.7	51.1	865	56.2	68.1	51	26.4	70.4	20			6.48	6.66	7.48
11.60	54.0	34.8	22.3	38.5	53.1	870	54.8	66.6	49	25.7	70.9	19	40	53	6.55	6.74	7.57
11.55	53.1	34.0	21.7	40.2	55.0	874	53.4	65.2	48	25.0	71.4	18			6.62	6.81	7.66
11.50	52.3	33.2	21.0	42.0	56.9	879	52.0	63.7	46	24.3	72.0	17	42	40	6.70	6.88	7.75
11.45	51.4	32.5	20.4	43.7	58.7	883	50.6	62.3	44	23.7	72.5	17			6.78	6.96	7.84
11.40	50.6	31.9	19.7	45.5	60.8	888	49.2	60.8	42	23.0	73.0	16	44	27	6.85	7.05	7.93
11.35	49.9	31.2	19.0	47.3	62.8	893	47.8	59.4	40	22.3	73.5	16			6.92	7.13	8.03
11.30	49.2	30.6	18.3	49.2	64.8	898	46.4	57.9	38	21.6	74.0	15	47	12	7.00	7.21	8.14
11.25	48.4	30.0	17.7	50.1	66.8	903	45.0	56.5	36	21.0	74.5				7.09	7.30	8.24
11.20	47.6	29.3	17.0	53.0	68.8	908	43.6	55.0	34	20.3	75.1		50	0	7.19	7.40	8.34
11.15	46.8	28.6	16.4	55.0	71.0	913	42.2	53.5	32						7.28	7.50	8.46
11.10	46.0	27.9	15.7	57.0	73.2	918	40.8	52.0	30				54	—20	7.37	7.61	8.59
11.05	45.2	27.2	15.1	59.0	75.5	923	39.4	50.5	29						7.47	7.71	8.71
11.00	44.5	26.4	14.4	61.0	77.8	928	38.0	49.0	27				57	—36	7.58	7.82	8.83
10.90	42.8	24.9	13.0	65.2		938			24				62				
10.80	41.1	23.4	11.7	69.5		948			20				67	—70			
10.70	39.4	22.0	10.4	73.7									73				
10.60	37.8	20.5	9.2										80	—115			
10.50	36.2	19.0	7.9										90				

*Approximate.

EXPLANATION OF COLUMNS

1. Characterization factor, cube root of absolute molal B.P. (° F. plus 460) divided by specific gravity at 60° F. Watson and Nelson, Ind. Eng. Chem., 25, 880 (1933).

2. Gravities nearly the same as high-quality gasolines.

3 and 4. Arithmetic average boiling point of key fractions No. 1 and No. 2 of the Bureau of Mines, Tech. Paper 610.

5 and 6. Correlation index of the Bureau of Mines (Tech. Paper 610) for key fractions Nos. 1 and No. 2. The average boiling points were determined from A.S.T.M. distillations of Bureau of Mines Hempel fractions.

7. $V.G.C. = \frac{10G - 1.0752 \log (V - 38)}{10 - \log (V - 38)}$ in which G is specific gravity at 60° F., and V is Universal Saybolt viscosity at 100° F., Hill and Coats, Ind. Eng. Chem., 20, 641 (1928). The constants shown here are for stocks with an average of 700° F. boiling point.

8 and 9. For fractions having average boiling points of 400° F. (heavy solvents), and 550° F. (light diesel fuels).

10. Diesel index $= \frac{\text{Aniline point (° F.)} \times \text{A.P.I. at 60° F.}}{100}$ For diesel fuels having an average boiling point of 550° F.

11. Characterization gravity is the average gravity of the fractions that boil at 350°, 450°, and 550° F. at 25-mm. pressure. This is about the equivalent of 680° F. at atmospheric pressure. Mithoff, MacPherson and Sipos, The Oil and Gas Journal, November 6, 1941, page 81.

12. Motor octane number of thermal cracked gasolines produced in plants with vapor reaction chambers. Computed from the characterization gravity, Pet. Ref. Eng., third edition, page 130, McGraw-Hill, 1949.

13. Institute of Petroleum Test K.36 for a fraction (kerosine) having an average boiling point of 430° F.

14. Approximate K.B. number based on the meager data of Questions on Technology, February 9, 1950. Scattered data and also those of Egloff and Nelson, The Oil and Gas Journal, January 2, 1936, page 34.

15. Viscosity index (approximate). Dean and Davis, Chem. Met. Eng., 36, 618 (1929).

16, 17, and 18. Carbon hydrogen ratios for fractions having average boiling points of 200°, 500°, and 900° F.

No. 397

Change of Well Capacity With Filtration

IN past installments of this series the discussion has concerned various means of changing well capacities. Another physical process to be considered from this standpoint is filtration, especially during the drilling of a well when particles of drilling fluid are deposited by filtration, or during injection processes where debris or specific filterable material is present.

The change in flow capacity due to filtration can be considered as a result of placing in series with the existing permeability a layer of material of lower permeability. The over-all change might then be computed by knowing the permeability and thickness of the new material.

In filtration the amount of solid material filtered is some function of the total quantity of fluid passed, which is in turn some function of the permeability of the formation where filtration is occurring. Thus, the change in flow capacity should be some function of the original permeability of the formation.

The total quantity of fluid passed is also some function of the time interval over which filtering occurs. The effect of a long exposure to filtering is to reduce all permeabilities to the same value, an amount controlled by the filter-cake permeability, assuming that its permeability is quite low.

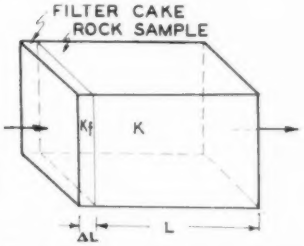


Fig. 1—Filtration occurring on a linear flow system.

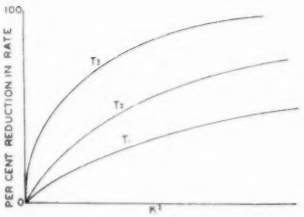


Fig. 2—Per cent reduction in rate of flow due to filtration as a function of permeability and time of flow.

An approach to the quantitative variation can be gained by assuming for instance, a linear flow system such as in Fig. 1. The filterable material forms a filter cake at the inlet end. Assume the permeability of the filter cake to be a constant, the thickness of filter cake to be increasing linearly with the total amount of flow, and the pressure at the inlet to be a constant. The thickness of the filter layer at any time is designated ΔL, the permeability of the sand system k, that of the filter cake k_f, and that of the entire system k_{avg}.

By the consideration of permeabilities in series, k_{avg} is at any time:

$$k_{avg} = \frac{L + \Delta L}{L/k + \Delta L/k_f} \quad (1)$$

and since L is substantially equal to $L + \Delta L$, multiplying by k/L gives:

$$k_{avg} = \frac{k}{1 + (\Delta Lk/Lk_f)} \quad (2)$$

The fractional reduction in permeability is therefore:

$$\frac{k - k_{avg}}{k} = \frac{\Delta Lk/Lk_f}{1 + (\Delta Lk/Lk_f)} \quad (3)$$

If the thickness of filter cake increases as the total throughput of fluid and the latter is directly proportional to the permeability and time, then as a first approximation:

$$\Delta L = \text{Const.} \times t \times k \quad (4)$$

can be substituted in Equation 3 to give:

$$\text{Permeability reduction} = \frac{tk^2}{\text{Const.} + tk^2}$$

This suggests a variation as shown in Fig. 2 for per cent reduction in rate as a function of permeability and time.

In the literature[1] there are reported reductions in permeability after filtering emulsions through core samples of varying permeabilities for different periods of time. A reproduced figure from this reference is in Fig. 3, where rate of flow is used on the x-axis in place of k^2 and the different curves represent different time intervals for filtration.

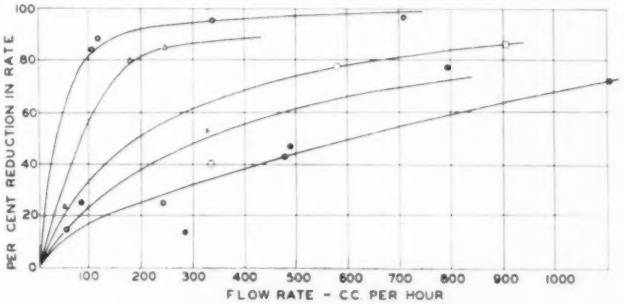


Fig. 3—Reduction in rate due to filtering of wax emulsions (Reference 1).

Reference

1. Calhoun—The Selective Shutoff of Watered Out Sands, sixth annual technical meeting, Bradford district Research Group, M. I. Expt. Station, Pennsylvania State College, State College, Pa.

Series by Dr. John C. Calhoun, Jr., Chairman, Petroleum Engineering School, University of Oklahoma

WHAT A LEADING TECHNICAL EDITOR WROTE ABOUT ALUMINUM TRANSITS AFTER ANALYZING HOW GURLEY MAKES THEM

Reproduced from a full-length article in the December 1949 issue of MATERIALS & METHODS, written by H. R. Clauser, its Associate Editor. We will gladly send you reprints of the entire article on request.

Aluminum Used Successfully in Precision Instruments

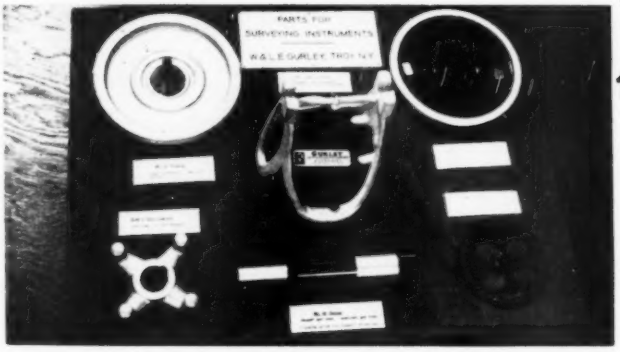
A PICTORIAL STORY

Requirements of accuracy during a long service life are controlling factors in selection of materials for engineering and surveying instruments.

• IN THE MANUFACTURE of precision instruments, the selection and careful processing of materials is of prime importance. Accuracy as well as long service life with a minimum of adjustment and repair are the quality standards that must be met, and to meet them, astute materials engineering coupled with expert workmanship are required. Perhaps no better example of the combination of these two factors can be found than at W. & L. E. Gurley, Troy, N. Y., where precision instruments are produced not only for engineering and surveying, but also for other fields such as meteorology and aeronautics.

Copper alloys and aluminum alloys are the principal materials used in the company's surveying instruments. One of the earliest uses of aluminum in this country was in a Gurley transit 73 years ago. And since that early application, aluminum has proved satisfactory in an increasing number of instrument parts. The main reasons for adopting the use of aluminum were: (1) light weight; (2) relatively high strength and yield point; (3) lends itself to precision machining; (4) good ductility; (5) relatively good corrosion resistance, especially in sulfur atmospheres; and (6) does not distort nor "grow" with age. The aluminum alloys most used at present are 14SW, 61ST, 356 and 13. A thorough test program insures against any differences in accuracy within a temperature range of —80 F and +165 F.

The accompanying pictures illustrate a number of the steps involved in the production of various parts making up the transit.



1—Shown here are the aluminum parts used in Gurley surveying instruments. At top, left and right is a 14SW forging for a horizontal transit limb before and after being machined, anodized and dyed. In the center is a sand casting of 356 alloy for the truss standard. Lower row, left to right, is a transit leveling head sand casting of 13 alloy, a swaged and spun tubing for telescope focusing slide of 51ST alloy, and a graduated vertical circle made of 61ST aluminum sheet which has been anodized and dyed.

You're So Right, Mr. Editor—

The first Gurley Aluminum Transit, built in 1876, was finally retired after 50 years of active service—and then for sentimental reasons only. It met every field "requirement of accuracy during a long service life"—as every Gurley Transit continues to do all over the world.

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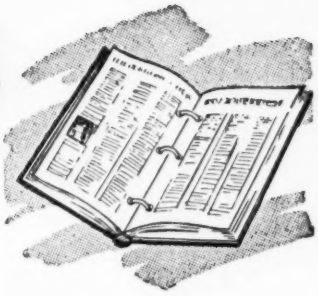
The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL



Pressure Control

THE method of controlling back pressure on a column indicated in Fig. 1 would be suitable where the overhead is small in quantity relative to the feed, and condensation is total. All the overhead that is condensed is pumped back as reflux. A substantially pure product is taken off overhead as gas or vapor. An example would be a deethanizer in which it was desired to keep down the loss of propane.

In Fig. 2 a method of control is shown which is applicable where the volume of vapor overhead is large and all of this is condensed. Overhead product with a narrow boiling range is removed as indicated. The diaphragm or butterfly valve in the overhead line would be large, and there might be some question about its cost and maintenance as balanced against benefits obtained from improved product quality. A valve positioner would be necessary to set the valve opening accurately regardless of valve friction and amount of valve movement.

In Fig. 3 an indirect control of temperature and hence vapor pressure of overhead product is obtained. It is assumed that virtually all overhead is condensed. If column in Fig. 3 were a depropanizer with small amount of propane leaving the condenser as vapor, a manual vent or self-acting regulator would be installed, as shown dotted in.

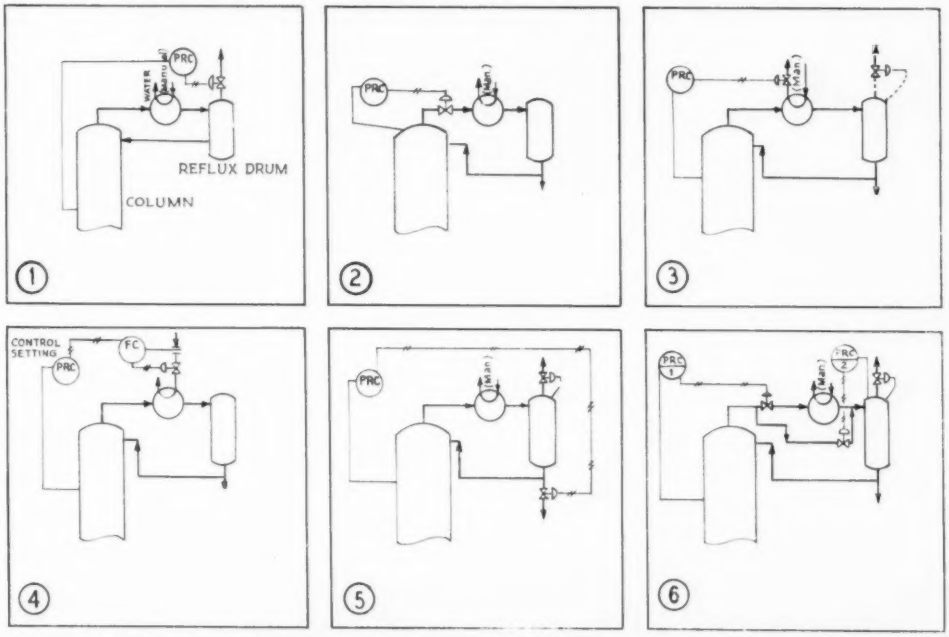
Since water pressure is usually not sufficiently constant, an interlock may be used as in Fig. 4. Here the pressure controller resets a flow controller which regulates the valve opening on the condenser water line. Changes in water pressure are thus compensated for and closer control, such as required for a deisobutanizer, is obtained.

By the method of Fig. 5 condenser water rate is manually set and rate of condensation indirectly controlled by controlling rate of withdrawal of liquid product to flood the condenser bundle to a greater or lesser extent as required.

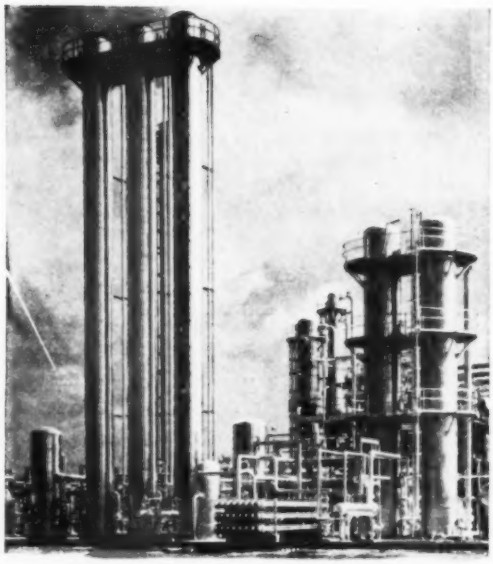
In both Figs. 3 and 5 control becomes unsatisfactory if amount of product withdrawn is small relative to amount of reflux. The method of Fig. 5 may lead also to subcooling of reflux.

The controller PRC-1 in Fig. 6 sets the valve opening in the main overhead vapor line in which a large quantity of vapor is flowing. The possibility of subcooling is avoided through bypassing some hot vapor, as shown, to the accumulator. PRC-2 operates the valve in the bypass to maintain a small constant pressure drop between the column and the reflux drum.

Some methods of controlling operating pressure on fractionating columns are indicated. These illustrate how instrumentation may be applied according to variations in the process.



No. 12 in current series. The Refiner's Notebook has been published continuously since 1944.



Southwest Gas Producing Co.—Uses

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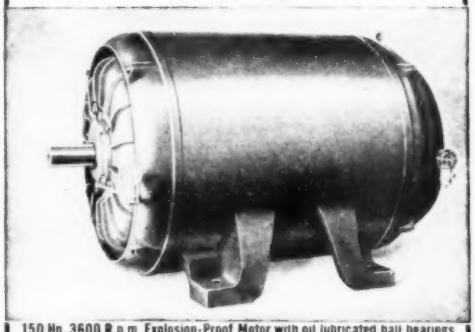

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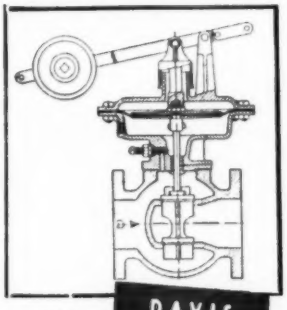

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NATURAL GAS

Plans Completed for Tulsa A.G.A. Meeting May 8-9

Plans have been completed for the spring conference of the Natural Gas Department, American Gas Association, which will be held at the Mayo Hotel in Tulsa May 8-9. Among a number of pertinent subjects to be discussed will be reserves, rates, and research in the natural-gas industry.

D. A. Hulcy, president, Lone Star Gas Co., and director of the Natural Gas Department, will preside at both general sessions, and will deliver the opening address May 8.

Elmer F. Schmidt, vice president of Lone Star Gas Co. and chairman of the technical and research committee of the department, will discuss research projects in the A.G.A. program that are specifically devoted to natural gas; Wesley E. Disney, counsel for Independent Natural Gas Association of America, will discuss recent court and commission decisions which may have an important effect on the rapidly expanding natural-gas business; and Hugh H. Cuthrell, vice president, Brooklyn Union Gas Co., and president of A.G.A., will discuss the rapid spread of the natural-gas pipeline systems in the United States and how A.G.A. is working to keep abreast of changing economic conditions.

Other speakers will include: N. C. McGowen, president, United Gas Pipe Line Co.; Arthur F. Bridge, president, Southern Counties Gas Co., Los Angeles; Guy T. Henry, president, Central Indiana Gas Co., Muncie, Ind.; Walter Herman, Commonwealth Services, Inc.; and Oliver S. Hagerman, president and general manager, Virginia Gas Transmission Corp.

Hearing in Phillips Case Postponed Until May 1

A hearing previously scheduled to begin in Bartlesville, Okla., March 20 on natural-gas operations of Phillips Petroleum Co., has been postponed by Federal Power Commission until May 1, at the company's request.

FPC also separated from the Phillips proceeding the application of Independent Natural Gas Co. and a joint application of Independent and Northern Natural Gas Co. Both previously had been consolidated and set for hearings with the Phillips case.

The commission is seeking to determine whether Phillips Petroleum is a natural-gas company within the meaning of the Natural Gas Act *(The Oil and Gas Journal, February 16, 1950, page 78)*.

Texas Eastern to Supply Natural Gas to Algonquin

A contract has been signed by Texas Eastern Transmission Corp. and Algonquin Gas Transmission Co., for delivery of up to 250,000,000 cu. ft. of natural gas daily by Texas Eastern to Algonquin for resale to utilities in the New England area.

Texas Eastern and Algonquin have applied to Federal Power Commission for authorization to construct the necessary facilities to serve the New England area. Hearings on the two applications are expected within the next few months. If favorable action is taken by FPC, actual construction can be started by the end of the year so that deliveries of gas may be started in time for the winter heating season of 1951-52.

Required new facilities, to be added to the Big Inch and Little Big Inch system, would cost approximately $60,000,000. The pipe-line system that Algonquin proposes to construct from a delivery point on the Big Inch system near Lambertville, N. J., to serve substantially all the gas distributing companies in the New England area would cost approximately $27,000,000.

American Republics Corp. May Convert Texas Plant

American Republics Corp., Houston, is contemplating conversion of the liquid-extraction section of its Joe's Lake pressure-maintenance plant in Tyler County, Texas, from compression type to absorption type.

Capacity would be 20,000,000 cu. ft. of gas daily, and 10,000 gal. of liquid. No liquefied petroleum gas production would be undertaken.

The plant's present input capacity is 6,500,000 cu. ft. daily, used for pressure maintenance. Liquid capacity is 15,000 gal. daily.

Natural Gasoline

Shell Announces Plans for Elk City Gasoline Plant

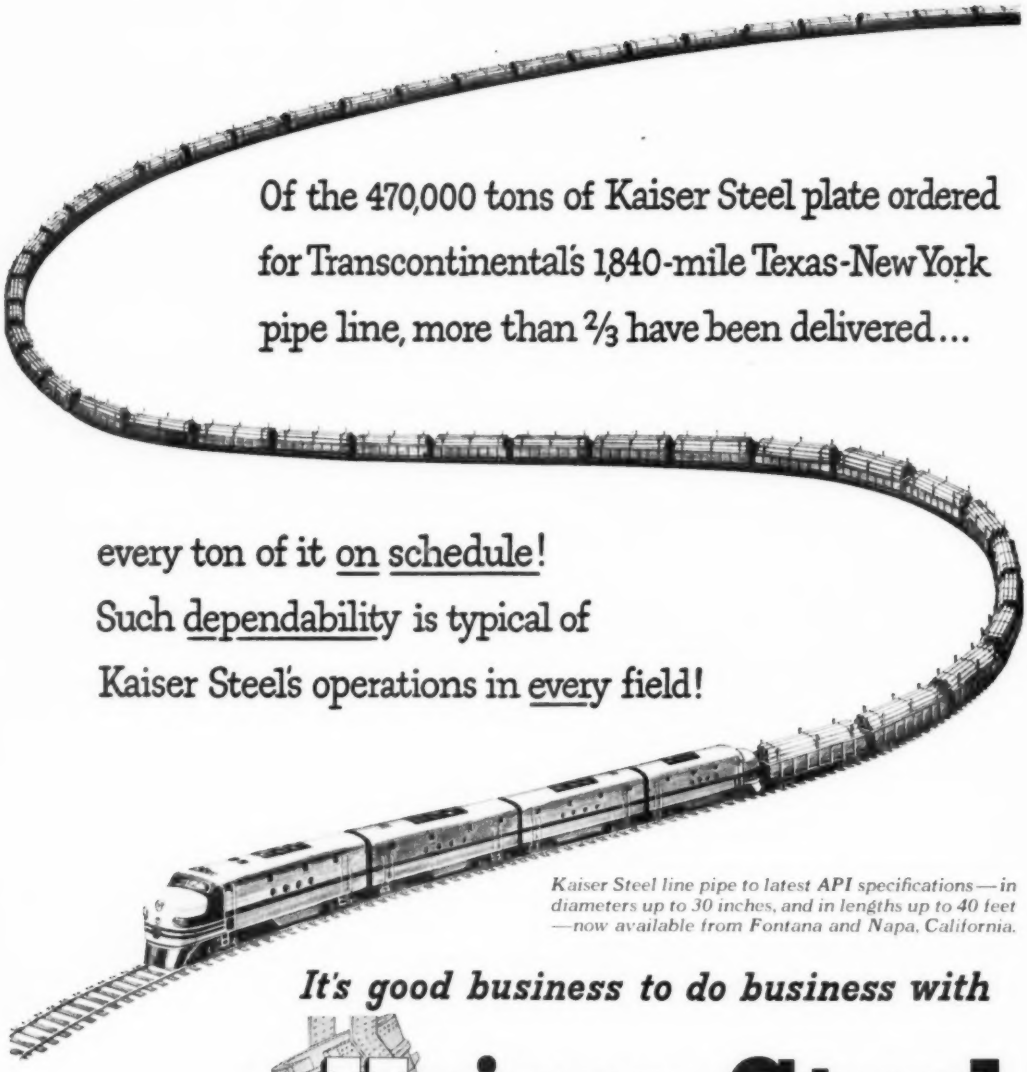
Plans have been announced for construction of a gasoline-extraction plant in the Elk City field of Beckham and Washita counties, Oklahoma, by Shell Oil Co. When completed, it will be capable of handling approximately 100,000,000 cu. ft. of gas daily, according to W. A. Alexander, Shell area manager, Tulsa.

The company was reported considering such a plant early this year *(The Oil and Gas Journal, January 12, 1950, page 101)* but the first official announcement of Shell's intentions was made last week in Tulsa. Refinery Maintenance Co., Houston, was awarded construction contract, and the facilities will be built immediately, Alexander said.

The plant will be designed to permit adoption of facilities to provide cycling, repressuring, and crude stabilization. Later revamping to handle these facilities, however, would depend on adoption of some plan to unitize interests of operators and royalty owners, Alexander said.

The total investment of Shell and other companies in the Elk City field is expected to exceed $32,000,000 by the end of 1950, Alexander reported. By conservative estimate, drilling alone represents a direct investment of $8,000,000, he said.

***BOOSTER STATION.**—Above is El Paso Natural Gas Co.'s Keystone field main-line booster station at Cheyenne, Tex., which has ten 1,500-hp. compressor engines and four 800-hp. auxiliaries. Completed in January, the station may have two more 1,500-hp. compressors added this year.*



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Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 22" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt Kaiser
Electric Resistance Weld—Plain End	5" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	24" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt Kaiser

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PIPE LINES

East Tennessee Natural Seeks to Build 139 Miles

Construction of approximately 139 miles of pipe line, extending from a point south of Knoxville, to Bristol, Tenn., is proposed in an application filed with Federal Power Commission by East Tennessee Natural Gas Co., Chattanooga.

Also proposed is an increase in the delivery capacity of the company's pipe-line system by 40,000,000 cu. ft. of natural gas daily.

The proposed facilities, estimated to cost $5,264,120, would provide natural-gas service to the markets and areas extending from Oak Ridge to Bristol, including Mascot, Jefferson City, Morristown, Johnson City, Elizabethton, Kingsport and Bristol, all in Tennessee.

The construction program includes 100 miles of 16-in. line, 21 miles of 6⅝-in. line, 18 miles of 8⅝-in. line, and a 1,400-hp. compressor station. East Tennessee expects to obtain its required additional gas supply from Tennessee Gas Transmission Co.

East Tennessee last spring was authorized by FPC to construct a pipe line for transportation of 60,000,000 cu. ft. of gas per day to the Atomic Energy Commission's Oak Ridge, Tenn., plant. The company's original application in that proceeding proposed the Bristol extension, but the plan was withdrawn in an amended application filed before hearings were held.

Large-Diameter Welded Pipe Mill Operating on Gulf

The first large-diameter welded steel pipe mill operation on a production-line basis in the Gulf Coast area is now producing on a limited scale.

Joseph J. Kane, president of Kane Boiler Works, Inc., Galveston, said that new installations at the plant will soon be making big-inch line pipe, up to 36 in. o.d. Production capacity at the pipe mill will exceed 10,000 tons per month when full-capacity turnout is under way.

Pipe sizes manufactured will be from 12¾ to 36-in. o.d., in 40-ft. lengths.

Hearing April 4 on Plan Of Southern Natural Gas

A hearing will begin April 4 in Washington, D. C., before Federal Power Commission on application of Southern Natural Gas Co., Birmingham, for authorization to expand its natural-gas transmission system which serves markets in Alabama, Georgia, Louisiana, and Mississippi.

The proposed program includes the construction of main-line additions, branch-line loops and connecting lines in Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina, and a new high-pressure line extending from the Gwinville (Miss.) gas field to Aiken, S. C.

Construction of the proposed facilities, estimated to cost $32,928,630, would increase the capacity of Southern Natural's pipe-line system by 109,000,000 cu. ft. per day to a total daily capacity of 529,000,000 cu. ft.

Tennessee Gas Transmission River Crossings Approved

Federal Power Commission has authorized Tennessee Gas Transmission Co., Houston, to install four 26-in. pipe lines on the Mississippi River highway bridge at Greenville, Miss., and an additional 28,800 ft. of 26-in. line to connect the bridge crossing with the company's natural-gas transmission system on both sides of the river.

Installation of the four pipe lines will involve replacing the existing concrete slab high on the bridge and reinforcing the present bridge structure so as to provide sufficient load-carrying capacity. Estimated cost of the project, including the bridge reinforcement program, is $2,355,880.

Tennessee's entire deliveries are now transported through two 18-in. lines on the Greenville bridge, and two 16-in. submerged lines near the Greenville bridge and are inadequate for the river crossing, the company said.

Carolina Natural Seeking To Build 372-Mile System

Carolina Natural Gas Corp., Charlotte, N. C., has asked Federal Power Commission to authorize construction of a 372-mile system of laterals to supply natural gas to distributors now serving manufactured gas in North and South Carolina communities.

At the same time the firm asked FPC to order Transcontinental Gas Pipe Line Corp. to connect its transmission system with the proposed lateral pipe-line system, and to sell natural gas to Carolina Natural. Trans-

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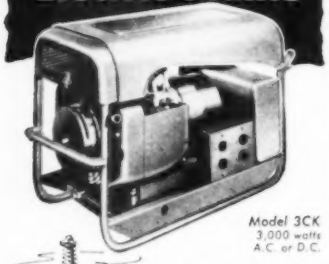

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continental is presently constructing a Texas-to-New York City pipe line, which is nearing completion.

Carolina Natural proposes to construct approximately 372 miles of line consisting of 18 lines having an aggregate design capacity of 140,000,000 cu. ft. of gas daily. They would extend laterally from Transcontinental's main transmission line, to the various market areas proposed to be served. Estimated cost of the facilities, including construction of metering and regulating stations, is $7,332,200.

Transcontinental Awards Gathering-Line Contracts

HOUSTON.—Transcontinental Gas Pipe Line Corp. has let contracts for 140 miles of gathering lines in the area south of Eunice, La. These contracts were awarded under the direction of Fish Constructors, Inc.

For this job O. R. Burden Construction Co. will lay 50 miles of 18 and 20-in. south from the 30-in. trunk line. Latex Construction Co. will lay 90 miles of line ranging from 4 to 14-in.

The Latex work will include a line from the Vinton field to the 30-in. trunk line and lines to feed into the system to be laid by Burden which would transmit gas from several fields including Egan, East White Lake, West White Lake, West Gueydan, Fresh Water Bayou, and Tigre Lagoon.

Mid-Valley Construction

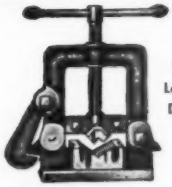
Unloading of pipe for Section 1 of Mid-Valley Pipe Line Co.'s 1,000-mile project started last week. Pipe laying will commence April 15. O. R. Burden Construction Co., contractor for this section, has established a field office at Marshall, Tex., and G. D. Lewis has been assigned as spreadman.

Construction Offices

In preparing for construction of a section of the Interprovincial Pipe Line Co. project, Williams Brothers Corp. has established a construction office at Soris, Man., Canada, under Whitey Martin, and an accounting office at Morden, Man., Canada, under supervision of B. E. Barnes. A field office is also being established at Tipling, Sask, Canada.

Canadian Line Approved

Approval has been given Interprovincial Pipe Line Co., Ltd., by the Canadian Board of Transport Commissioners, for construction of a 30-mile link to its Edmonton-Great Lakes crude-oil line. The 16-in. extension will run from Redwater to Edmonton, and will handle up to 100,000 bbl. of crude daily.



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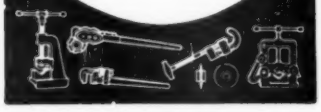

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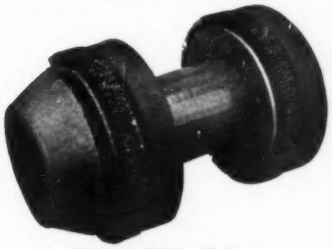

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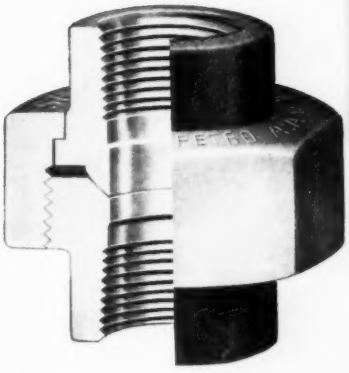

Write Dept. G for illustrated catalog or refer to listings in Composite Catalog pages 3082-3083, Chemical Engineering Catalog pages 980-981 and Refinery Catalog page 546.

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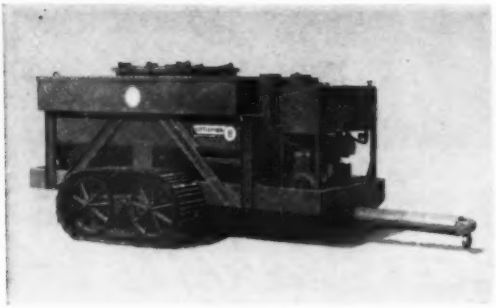

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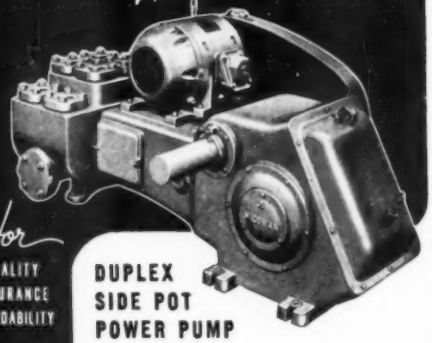

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Pipe-Line Construction

FOLLOWING is a tabulation of pipe-line projects, both domestic and foreign, which are planned or under construction. Included are crude-oil, products, and natural-gas lines. The list was compiled from surveys made by The Oil and Gas Journal.

Crude-Oil Pipe Lines—Domestic

Gulf Refining Co.—29 miles 8-10-in. lateral in Scurry County, Texas, under construction; Latex Construction Co., contractor; J. B. Latham, superintendent; field office, Loraine, Tex.

Humble Pipe Line Co.—371 miles, 18-in., under way, West Texas-Satsuma Station to Baytown, Tex.; 178-mile western section contracted to Morrison Construction Co.; 193-mile eastern section contracted by Anderson Brothers Corp.

Magnolia Petroleum Co.—60 miles 4-24-in. gathering system in La Ward and Lolita fields, Texas; Henry L. Lemons & Co., contractor; W. A. Remington in charge.

Mid-Valley Pipe Line Co. (Sun and Sohio)—1,000 miles, 20-22-in., under way, Longview, Tex., to Mayersville, Miss.-Covington, Ky., to Lima, Ohio. Contracts let for 857 miles as follows: Section 2, Haynesville, La., to Mayersville, Miss., Latex Construction Co.; spread office, Farmerville, La.; F. A. Silar, general superintendent; W. A. Briley, spread superintendent; office at Haynesville, La., W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent. 41 miles, 12-in., lateral, Delhi to Lake Providence, La.; headquarters, Lake Providence; E. C. Norris, general superintendent; R. E. Thornton, superintendent. Section 3-A, Mayersville to Oakland, Miss., Associated Pipe Line Contractors, Inc.; J. A. Williams and L. H. Gray, spreadmen; Section 3-B, 4-A, Oakland, Miss., to Henderson, Tenn., Eastern Construction Co.; Section 4-B, 5-A, Henderson to Clarksville, Tenn., Eastern Construction Co.; Section 5-B, 6-A, Clarksville, Tenn., to Elizabethtown, Ky., field office, Clarksville, Tenn., Fred L. Byers, superintendent; Britton Construction Co.; Section 6-B, 111 miles of 22-in., Elizabethtown to Hebron, Ky., H. L. Gentry Construction Co., Frank Morris and Jim Mitchell, spreadmen; Section 7 South, Hebron, Ky., to Eaton, Ohio, Britton Construction Co., field office, Hamilton, Ohio; spreadman, Fred Peters; Section 7 North, Eaton to Lima, Ohio; Section 8, Magnolia, Ark., to Haynesville, La. Longview, Tex.-Haynesville, La., section, 110 miles 20-in., contracted to O. R. Burden Construction Co. Cumberland and Tennessee rivers, Eastern Construction Co.; field office, Clarksville, Tenn., Fred L. Byers, spreadman.

Naph-Sol Refining Co.—25 miles 6-in., under construction, Kimball Lake oil field, Newaygo County, Michigan, to refinery at Muskegon; Young Construction Co., Olney, Ill., contractor.

Phillips Petroleum Co.—45 miles 2-24-in., gathering system near Andrews, Tex.; Vaughn & Taylor Construction Co., contractor; Jess Moore in charge.

Pasotex Pipe Line Co.—32 miles 4-8-in., authorized, North Snyder, Tex., lines for gathering, delivery to Basin System.

Portland Pipe Line Co., Montreal Pipe Line Co., Ltd.—236 miles, 18-in., planned, Portland, Me., to Montreal, Que., Canada, contracted as follows: Oklahoma Contracting Co., 85 miles in Section 1 at southern end; Portland, Me., to Gorham, N. H. Associated Pipeline Contractors, Inc.; L. H. Gray, spreadman, Section 2, 81 miles; and Fred Mannix Co., Ltd., 68 miles, Section 3, in Canada.

Richfield Oil Corp.—40 miles, 10-in., Cuyama Valley-Newhall, Calif., planned; Bechtel Corp., contractor; central plant, Watson, Calif., 60 miles, 14-in., applying field joints, Newhall-Wilmington, Calif.; under way; Bechtel Corp., contractor.

Stanolind Pipe Line Co.—36 miles, in Kent County, Texas, outlet for Scurry County crude.

Texas-Empire Pipe Line Co.—42 miles, 16-in., authorized, Wilmington, Ill., to East Chicago, Ind.; O. E. Burden Construction Co., contractor.

Texas Pipe Line Co.—42 miles 12¾-in., Patoka, Ill., to Clay City, Ill.; L. R. Young Construction Co., contractor.

Texas-New Mexico Pipe Line Co.—37 miles, 10-in., proposed, Scurry County, Texas.

Products Pipe Lines—Domestic

Great Lakes Pipe Line Co.—261 miles, 12-in., under way; contracted as follows: 52 miles, 15-in., Albert Lea to Fairbault, Minn.; under construction; Sheehan Pipe Line Construction Co., contractor; field office, Albert Lea, Minn.; C. W. Henderson, spreadman. O. R. Burden Construction Co., 64 miles north from Des Moines; field office, Nevada, Iowa; G. D. Lewis, spreadman; A. C. Holder Construction Co., 72 miles to Iowa-Minnesota state line; Williams Brothers Corp., 20 miles, Mississippi River crossing and line to terminal and station. Kansas and Missouri river crossings, R. H. Fulton & Co.; field office, Kansas City; Ed Veach, spreadman.

290 miles, 12-in., Tulsa to Kansas City, Mo. Contracted as follows: 54 miles, Ponca City to Barnsdall, Okla., O. R. Borden Construction Co.; and 236 miles, Barnsdall, Okla.-Kansas City, Mo., Pacific Pipe Line & Engineers, Ltd. James Howe, superintendent for Pacific Pipe Line portion is headquartered at Chanute, Kans.; spread office at Tulsa with Ham Hamilton general spreadman and river-crossing spreadman; spread office at Dewey, Okla., Loue Robertson, spreadman; and spread office at Paola, Kans., Larry Webb, spreadman.

355 miles, 12-in., authorized, Kansas City through Omaha and Sioux City, Iowa, to Sioux Falls, S. D.

189 miles, 12-in., authorized, Kansas City to Des Moines, contracted as follows: 33 miles 12-in., Kansas City, Mo., northward through Platte, Neb.; Trojan Construction Co., contractor; field office, North Kansas City, Mo.; Swede Tillotson, spreadman; 37½ miles, 12-in., Clay, Clinton, DeKalb, and Daviess counties, Missouri; Trojan Construction Co., contractor; field office, Cameron, Mo.; Maurice Crawford, spreadman, Brodie Construction Co., 37-mile middle section; field office, Bethany, Mo.; A. T. Rathjen, spreadman; R. H. Fulton & Co., two 38-mile northern sections.

48 miles, 8-in., authorized, Cushing-Drumright-Tulsa, Okla.; Trojan Construction Co., contractor; field office, Sapulpa Okla.; Al Johnson, spreadman.

Phillips Petroleum Co.—155 miles 6-in., extension to present 200-mile line from Phillips, Tex., to LaJunta, Colo., on to Denver.

Standard Oil Co. (Ohio).—38 miles 8-in., authorized, Toledo to Fostoria, Ohio.

Salt Lake Pipe Line Co.—242 miles, 6-8-in., Boise, Idaho-Pasco, Wash., planned. Contracted as follows: Morrison-Knudson Co., Inc., Macco Corp., and Bechtel Corp. 140-mile section from Boise to Baker, Idaho; Pacific Pipeline & Engineers, Ltd., Baker to Pasco, Wash.

Natural-Gas Pipe Lines—Domestic

Alabama-Tennessee Natural Gas Co.—80 miles 10-in., under way, Selmer, Tenn., to Muscle Shoals, Ala.; 35 miles 8-in., authorized, Muscle Shoals to Decatur, Ala.

Algonquin Gas Transmission Co.—276

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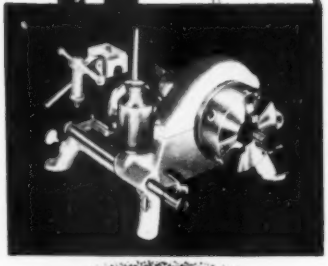

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miles, Lambertville, N. J., to Boston area, proposed.

492 miles laterals, New England area, proposed.

Atlantic Gulf Gas Co. (United Gas Pipe Line Co.)—1,530 miles, planned, Alabama-Florida-Georgia-South Carolina.

Central Hudson Gas & Electric Corp.—40 miles, authorized, Tuxedo, N. Y., station, Home Gas Co. line now under construction, to Poughkeepsie, N. Y.

Central Kentucky Natural Gas Co.—36 miles, 12-20-in., planned, Kentucky loops.

Chicago District Pipe Line Co.—41 miles, 24-in., planned, Joliet, Ill., to Chicago.

City of Indianapolis, Ind., Inc.—55 miles 16-in., proposed, Indianapolis to Texas Eastern Transmission Corp.'s system.

Cities Service Gas Co.—47 miles, 3-4-16-in. planned, in Kansas.

Coastal Pipe Line Co.—1,000 miles, planned, Texas to Norfolk, Va.

Colorado-Wyoming Gas Co.—41 miles, planned, Greeley, LaSalle, and Windsor, Colo., areas.

Commonwealth Natural Gas Corp.—537 miles, 20-in., planned, West Bend, Ky., to Norfolk, Va.

200 miles, planned, Green County, Virginia, to Norfolk.

East Tennessee Natural Gas Co.—18 miles, 16-in., Lobelville-Chattanooga, Tenn., contracted by Walters & Saigh Construction Co., for construction in 1950; 120 miles, 12-in., Chatanooga-Knoxville, Tenn.; contracted by Walter and Saigh Construction Co., for construction in 1950; 100 miles of laterals to be laid in 1950. Construction 150 miles, 16-in., Knoxville-Bristol, Tenn., under consideration.

El Paso Natural Gas Co.—All work done by company crews.

Looping of 26-in., New Mexico-California line and connection with Pacific Gas & Electric Co. at Needles, Calif. 352 miles, 30-in., completion November 1950.

450 miles, 30-in., under construction, Eunice, N. M.-Blythe, Calif., looping; completion March 1950.

450 miles, 24-in., planned, San Juan basin, New Mexico to Franconia, Ariz.

Home Gas Co.—70 miles, planned, Orange, Sullivan-Rockland counties, New York-Cattaraugus County, New York, areas.

Jersey Central Power & Light Co.—39.4 miles, 10-in., planned, New Jersey to Coast system, Texas Eastern Transmission Co.'s Big Inch.

Michigan-Wisconsin Gas Co.—185 miles 4-14-in. laterals, Milwaukee-Fond du Lac Sheboygan, and Green Bay, Wis., under construction; C. C. Griffis Construction Co. contractor; Paul Means, superintendent for Lake Del Mort crossing.

Montana-Dakota Utilities Co. and Montana-Wyoming Gas Pipe Line Co.—340 miles, 12¾-in., planned, Worland, Wyo., to Cabin Creek, Mont.; R. A. Conyes Construction Corp., contractor; Al Poggi, general superintendent; Chester Kincaid and Jimmy Alman, spreadmen.

Montana Power Co.—83 miles, 12-in., planned, Butte to Bozeman, Mont.; field office, Three Forks, Mont.; C. N. Deaton, spreadman.

New York State Natural Gas Corp.—53½ miles 16-in., loops, Pennsylvania.

Northeastern Gas Transmission Co.—511 miles, up to 20-in., planned, in New England area.

Northern Natural Gas Co.—41 miles, 20 in., under construction, Southwest from Garden City, Kans.; R. H. Fulton & Co. contractor.

597 miles of looping in 10 sections, contracted as follows: R. H. Fulton & Co., loops 1 to 5: loop 1, 40.2 miles, 26-in., extending northward from a point 28.7 miles north of Skellytown station in Pampa, Tex., area; loop 2, Beaver, Okla., station, 74.9 miles, 26-in.; loop 3, Mullinville, Kans., station, 33¼ miles, 26-in.; loop 4, Bushton, Kans., station, 72½ miles, 26-in.; loop 5, from a point west fo Garden City, Kans., to Bushton, Kans., station, 155 miles, 20-in. Midwestern Constructors, Inc., loops 6 and 7; loop 6, from a point 29 miles northeast of Palmyra, Nebr., station, 43.4 miles, 26-in. to Oakland, Iowa, station; loop 7, from a point 17.8 miles northeast of Oakland, Iowa station, 65.9 miles, 26-in. R. B. Potashnick,

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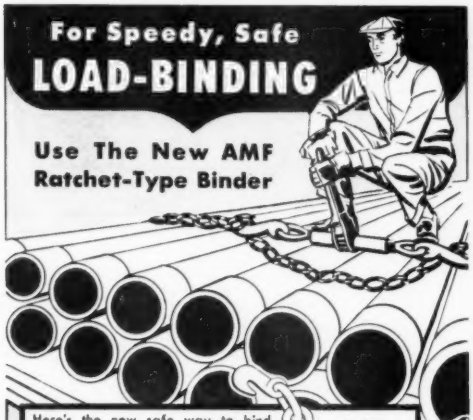

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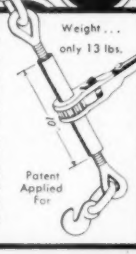

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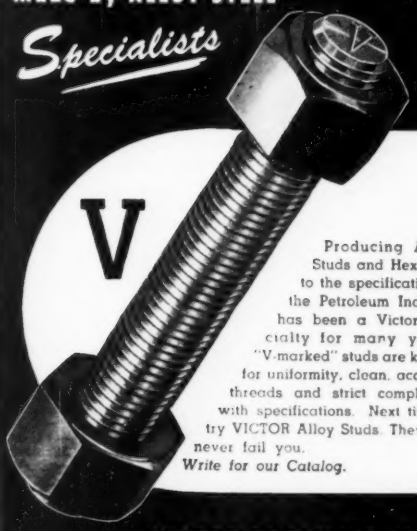

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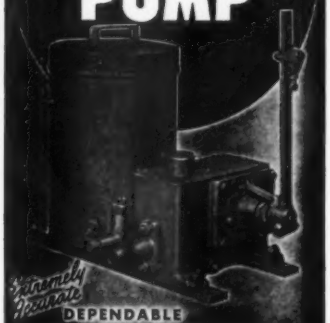

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loops 8 to 10: loop 8, southwestward from Ventura, Iowa, station, 31.2 miles, 26-in.; loop 9, northward from Ventura station, 41 miles, 26-in.; loop 10, from the north end of a 26-mile gap beyond loop 9, where another loop will be built consisting of 39½ miles, 26-in.; total 111 miles, 24-in.; field office to be located at Ogden, Iowa, June 1; Boyd, spreadman.

Northwest Natural Gas Co.—750 miles planned; Washington, Oregon, and Idaho.

Pacific Gas & Electric Co.—506 miles, 34-in., under construction, Topock, Ariz.-Milpitas, Calif.; Bechtel-Price-Conyes, contractor; main-line office, Barstow, Calif.; R. L. Bowman, general superintendent.

Panhandle Eastern Pipe Line Co.—350 miles, 26-in., authorized, looping in Texas, Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan.

Peoples Gas Light & Coke Co.—Planned 42 miles, 24-in., Joliet-Chicago, Ill.

Phillips Petroleum Co.—25 miles gathering system in West Edmond, Okla., field under construction; Vaughn & Taylor Construction Co., Inc., contractor; spread office Edmond, Okla.

118 miles, 3-to-20-in., gas-gathering system in Sherman and Hansford counties, Texas; Vaughn & Taylor Construction Co., Inc., contractor; D. D. Vaughn, spreadman; field office, Texhoma, Okla.

Piedmont Natural Gas Corp.—1,350 miles 20-in., planned, Greenville, Miss., to Norfolk, Va.

Plains Natural Gas Co.—78 miles, gathering system, Oklahoma-Kansas area, Hugoton field. Contracted by: Arey-Phillips Construction Co., Amarillo, Tex.; Tulsa Pipe Coating Co., Mid-Western Constructors, Inc., Engineering and supervision. Latter firm represented by Lyle DeWitt; field office, Liberal, Kans.

Roanoke Pipe Line Co.—30 miles 8-in., Gala, Va., to Roanoke, authorized.

South Jersey Gas Co.—77 miles, planned, Camden to Atlantic City.

Southern California Gas Co.—80 miles 30-in., Whitewater to Puente, Calif., planned.

Southern Natural Gas Co.—375 miles, 24-in., planned, Gwinville, Miss., to Atlanta.

225 miles, 16-in., planned, Colfax, Ga., extension.

110 miles, 11-in., considered; extension.

314 miles, 18-in., planned; extension.

171 miles, 16-in., planned; extension.

118 miles, 13-in., planned; extension.

Southern Union Gas Co.—78 miles, 8-10-14-in., planned, New Mexico loops and laterals.

Tennessee Gas Transmission Co.—65 miles, 16-in., planned, Ohio-Pittsburgh spur.

790 miles, 20-26-in., planned, Burnaugh, Ky., to Boston, including 400-mile line to Buffalo.

992 miles, 30-in., planned, first 150 miles of loops to be laid at Monroe, La., Greenville, Miss., Midland and Portland, Tenn.

54.2 miles, 30-in., under construction, White Bluff area to Joelton, Tenn., area, contracted to Morrison Construction Co.

36.1 miles, 30-in., under construction, Glasgow, Ky., area to Joelton area, contracted to Morrison Construction Co.

18.1 miles, 30-in., under construction, Union City to Buckeye, Ky., Anderson Brothers Corp., contractors.

27.7 miles, 12-in., under construction, El Campo, Tex., to near Traitor, Tex.; Massey Construction Co., contractor.

25 miles, 30-in., Hardeman and McNairy counties, Tennessee; H. C. Price Co.; field office, Selmer, Tenn.; J. A. Reutzel, spreadman.

70 miles, 26-30-in., between stations 104 and 110; Anderson Brothers Corp.; field office, Richmond, Ky.; E. C. McCoy and Arkie Hobson, spreadmen.

170 miles of 26 and 30-in., contracted by Anderson Brothers Corp., in Kentucky.

Texas-Eastern Transmission Corp.—1,400 miles planned, Texas to Pittsburgh loops.

108 miles 16-in., authorized, Provident City to Baytown, Tex.

33 miles, 20-in., Hankamer to Beaumont, Tex.; Associated Pipe Line Construction, Inc., contractor; field office, Liberty, Tex.; C. E. Rogers, spreadman.

Texas Gas Transmission Corp.—100 miles, 20-in., Carthage, Tex., to near Lisbon, La., (Sharon), under construction; N. A. Saigh Co., Inc., contractor; Carthage, Tex.; Bob Floyd, representative. Construction subcontracted: (1) Fowler Brothers, 43 miles from Carthage to Red River, field office at Carthage; M. C. Johnson, spreadman; (2) 63 miles to Sharon station, Oklahoma Contracting Co. (J. R. Horrigan) field office at Minden, La.; Ed Flanagan, spreadman.

32 miles, planned, Slaughters, Ky., to Evansville, Ind.

Texas Illinois Natural Gas Pipeline Co.—1,400 miles, 30-in., planned, La Gloria field, Texas, to Joliet, Ill.

58-mile, 20-in. lateral, Joliet terminal to

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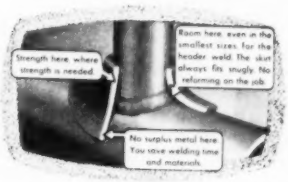
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Transcontinental Gas Pipe Line Co.—Texas-New York 1,840 miles, 30-in., main line and 500 miles, 4 to 22-in., gathering line. Section of 605 miles of 30-in. nearing completion.

Section (unnumbered), Rio Grande Valley to Eunice, La., 502 miles; contracts not let. Section 6, Newman, Ga., to Danielsville, Ga., 108 miles; Williams Brothers Co.; field office, Monroe, Ga.; Thelmer Davis, spreadman. Section 7, Danielsville, Ga., to Saluda River, South Carolina, 86 miles; Williams Brothers Co. Section 8, Saluda River, South Carolina, to Catawba River, North Carolina, 102 miles; R. H. Fulton & Co. Section 9, Catawba River, North Carolina, to North Carolina Virginia boundary, 100 miles; R. H. Fulton & Co.; A. A. Corrigan, superintendent, Clark Williams, general superintendent. Section 10, North Carolina-Virginia boundary to James River, Virginia; 86 miles; O. R. Smith Contracting Corp. Section 11, James River, Virginia, to Potomac River, Virginia; 110 miles; O. R. Smith Contracting Corp. Section 12, Potomac River, Virginia, to Susquehanna River Pennsylvania, 76 miles; Associated Engineers & Contractors, Inc. Section 13, Susquehanna, Pennsylvania, to Delaware River 90 miles; Wunderlich & Griffis Construction Co. Section 14, Delaware River to Hackensack River, New Jersey, 61 miles. Wunderlich & Griffis Construction Co. Section (unnumbered), Hackensack River New Jersey, to Hudson River, New York 23 miles; Oklahoma Contracting Co.; field office, Edgewater, N. J.; M. E. Shiflett spreadman.

Trunkline Gas Supply Co.—1,775 miles 10-26-in., planned; includes 740-mile, 26-in main line from Lake Charles, La., to Tuscola compressor station on Panhandle Eastern Pipe Line Co., and 1,035 miles, 10 24-in. Lake Charles, La., to McAllen, Tex. field lines, pending FPC approval of changed plans.

United Fuel Gas Co.—32 miles, 20-in. authorized; Roane, Calhoun, and Wetzel counties, West Virginia.

United Gas Pipe Line Co.—90 miles 16-in., planned, West Bay field to New Orleans.

105.6 miles, 20-in., authorized, loop line paralleling Carthage, Tex.-Sterlington, La. and extending on to near Monroe, La.

26 miles in Louisiana conecting with East Texas system, planned.

United Natural Gas Co.—29 miles, 12-in. authorized, laterals, Elk County, Pennsylvania.

Virginia Natural Gas Co.—153 miles planned, Buckingham to Richmond and Portsmouth, Va.

Crude-Oil Pipe Lines—Foreign

Interprovincial Pipe Line Co. (Imperial)—1,150 miles, 16-20-in., Edmonton area, to Superior, Wis.; contracted as follows: 441 miles, 20-in., Edmonton-Regina, Canadian-Bechtel, Ltd., associated with Fred Mannix Co., Calgary, Alta.; 340 miles, 16-in., Regina to Gretna, Man., Williams Brothers Corp.; 360 miles, 18-in., Minnesota and Wisconsin, Anderson Brothers Corp. (Lake Head Pipe Line Co., Inc.).

Iraq Petroleum Co., Ltd.—620 miles, 16-in., Kirkuk-Haifa, Palestine, shut down.

556 miles, 30-32-in., planned, Kirkuk, Iraq-Banias, Lakatia (Bechtel).

Middle East Pipe Line Co.—800 miles, 34-36-in., planned, Iran-Levantine Port.

Montreal Pipe Line Co., Ltd.—(See Portland Pipe Line Co. item in domestic crude oil list.)

Petroleos Mexicanos—280 miles, 12¾-in., authorized, Poza Rica to Salamanca, Mexico.

Santos Jundial Railroad—30 miles, 18-in., planned, Santos to Sao Paulo, Brazil.

Trans-Arabian Pipe Line Co.—1,067 miles, 30-31-in., under construction, Abqaiq, Saudi Arabia, to Sidon, Lebanon; International Bechtel, Inc., Williams Brothers Corp., Graver Tank & Mfg. Co., and Chicago Bridge & Iron Co., contractors.

Yacimientos Petroliferos Fiscales de Argentina.—25 miles, under way, Tupungato-Lujan de Cuyo.

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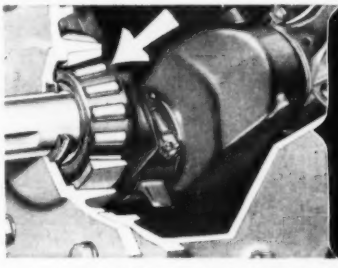

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2. Tapered Roller Bearings *resist wear* to a greater extent than other types of bearings not only because of the file-hard surfaces of Timken Tapered Bearings but also because these bearings are inherently SELF-CLEANING. Oil enters at the smaller end of tapered roller bearings and centrifugal force carries it out through the large end, thus preventing accumulations of dirt and sludge that is often present in the oil. (Tapered bearings cannot develop shaft-cutting abrasive surfaces.

3. Tapered Roller Bearings permit flexing of the crankshaft to a much greater degree than the longer, rigid plain bearings which cannot stand up under flexing conditions, resulting in wearing "bell-mouthed" or failing completely. We have yet to hear of a single case of Wisconsin Engine bearing failure. The use of Tapered Roller Bearings in ALL Wisconsin Engines from the smallest to the largest . . . 3 to 30 hp., single cylinder, 2-cylinder and 4-cylinder . . . is typical of the engineering diligence devoted to providing the user with "Most H.P. Hours of on-the-job service".

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REFINING

Contract Let for McPherson Refinery Modernization

Refinery Engineering Co., Tulsa, has been awarded a contract to supervise construction, under license from Universal Oil Products Co., of facilities which will enlarge and modernize the National Co-Operative Refinery Association refinery at McPherson, Kans. Estimated cost of the work has been set at $2,000,000.

Plant capacity will be raised from 18,000 to 22,000 bbl. daily by new facilities, which will include a catalytic cracking unit, polymerization unit, and modernization of existing equipment.

The refinery's tank farm will be enlarged to handle 1,700,000 bbl. of crude, or more than 200,000 bbl. more capacity than at present.

A 30-mile, 8-in. pipe line from the Lyons area, in Rice County, Kansas, will be laid by the Co-Ops, to the McPherson plant.

Premier to Revamp Thermal Unit at Fort Worth Plant

Premier Petroleum Co. will revamp the thermal unit at its Fort Worth refinery within the next few months, at a cost of several thousand dollars.

The revamping will be the first of an extensive modernization and enlargement program planned for the refinery, according to Lawrence B. Connelley, superintendent.

Engineering work will be done by the company's own engineers, it was reported.

Lube Production, Shipments Up in Mid-Continent Area

Lubricating-oils production and shipments in the Mid-Continent area increased in January for the first time in a number of months, Western Petroleum Refiners Association reported last week.

The report, prepared by W.P.R.A. statistics covering 13 reporting companies, disclosed that production in January totaled 1,253,321 bbl., an increase of 19,023 bbl., or 1.5 per cent from the same month a year ago.

Total January shipments were 1,249,965 bbl., up 211,334 bbl., or 20.3 per cent from the same month in 1948. Domestic shipments in that period were 1,189,433 bbl., up 180,937, or 17.9 per cent. Export shipments more than doubled, rising 30,397 bbl. to 60,532 bbl., or an increase of 100.9 per cent.

Stocks on hand at the end of January 1949 were 1,658,889 bbl., down 54,816 bbl., or 3.2 per cent.

Three Refineries Idled by Strike in Appalachian Area

Three refineries of Quaker State Oil Refining Corp. are idle due to a strike of 425 members of the Oil Workers International Union (C.I.O.).

Approximately 85 men at the Oil City, Pa., plant left their jobs last week, and refineries at St. Mary's, W. Va., and Emlenton, Pa., were idled due to the strike. About 150 men are out at St. Mary's and 190 at Emlenton.

Quaker State's fourth refinery, at Farmer's Valley, Pa., is still operating. The union contract at that plant has not expired.

Labor contracts at the three struck plants ended in January and February, and negotiations have been in progress since early December with the U. S. Conciliation Service attending the talks.

A.S.L.E. National Meeting Set April 10-12 at Detroit

Preparations are being made for the fifth annual convention of the American Society of Lubrication Engineers, which will be held at Hotel Statler in Detroit April 10-12. Many important subjects pertinent to the A.S.L.E. will be discussed during the convention, and the lubrication exhibit will run concurrently.

Divided into sessions, the convention will be devoted to discussions on plant-lubrication practices, oil reclaiming, and lubricating oils in refrigeration.

D. M. Cleaveland, Bendix Products Division, Bendix Aviation Corp., will deliver a paper on "Reclaiming Industrial Petroleum Products" and E. S. Rose, Sun Oil Co., will discuss lubricating oils in refrigeration.

Ethyl Corp., Du Pont Cut Price of Lead Compounds

Ethyl Corp. on March 13 announced a reduction in the price of "Ethyl" antiknock compound, to be effective for all shipments made on and after March 10, and E. I. du Pont de Nemours & Co., Inc., followed by reducing prices on its tetraethyl lead.

The new prices on "Ethyl" brand are 55.4 cents per pound of tetraethyl-lead content (approximately 0.2015

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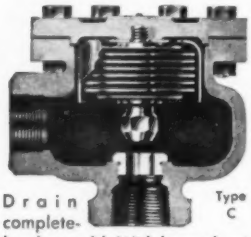

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per cubic centimeter of tetraethyl lead) for motor mix, and 60.9 cents per pound (approximately 0.2215 cent per cubic centimeter of tetraethyl lead) for aviation mix.

Du Pont reduced 2.3 per cent the cost for tetraethyl-lead compound motor mix, and 2.1 per cent for aviation mix. Prices became effective as of March 10.

Price of the du Pont motor mix is 34.06 cents per pound, equal approximately to 55.4 cents a pound and 0.2015 cent a cubic centimeter of tetraethyl-lead content. New price for aviation mix is 37.4 cents per pound, equal approximately to 60.9 cents per pound and 0.2215 cent per cubic centimeter of tetraethyl-lead content.

Work on Shell's Montreal Refinery Is Progressing

Shell Oil Co.'s annual report discloses that work on Shell Oil Co. of Canada, Ltd.'s, Montreal refinery is progressing rapidly, and that in all probability the expansion program will be completed by the latter part of this year.

New tankage has already been erected, much of the steel and new equipment moved on the site, and most of the important foundations have been poured.

Facilities have been designed to raise the over-all capacity from 14,000 to 25,000 bbl. per day, and include distillation and thermal cracking units.

Demand for Asphalt Dropped In 1949, Report Discloses

The U. S. Bureau of Mines reported last week that domestic demand for asphalt totaled 49,378,000 bbl. in 1949, a decrease of 1.2 per cent, or 584,000 bbl. over 1948. Production totaled 49,007,000 bbl., off 2,912,000 bbl., or 5.6 per cent.

Production in December 1949 declined 392,000 bbl., or 11.9 per cent, to 2,916,000 bbl.

Stocks on hand at the end of the year were 4,918,000 bbl. compared with 5,657,000 bbl. on hand a year earlier.

December demand was set at 2,282,000 bbl., down 4,000 bbl., or 0.2 per cent from the same month in 1948.

Sinclair Will Market New Multipurpose Grease Soon

A new multipurpose grease, which has been undergoing testing in the laboratory and on the road for more than a year, will be placed on the market by Sinclair Refining Co., April 1. It will enable service-station operators to reduce inventories of both equipment and supplies, eliminate the hazard of error, and permit faster vehicle servicing.

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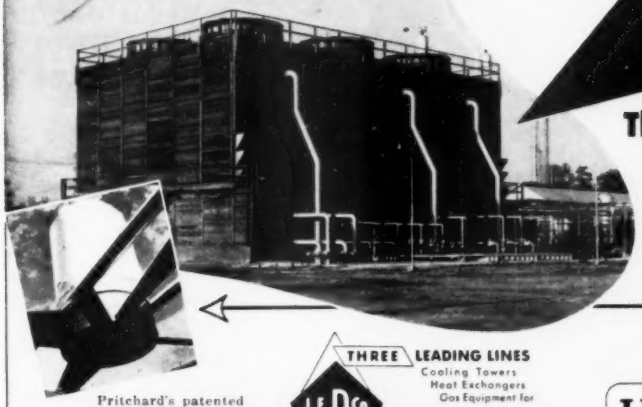

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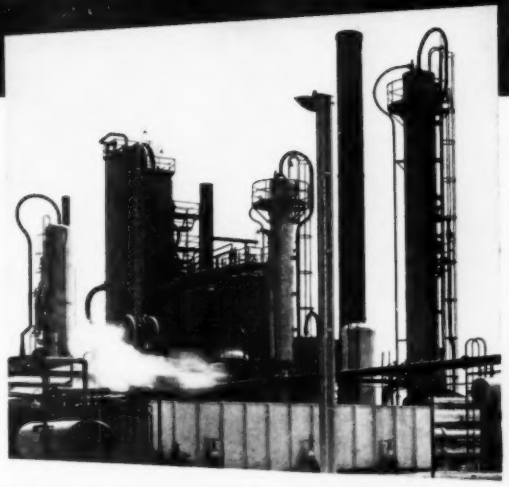

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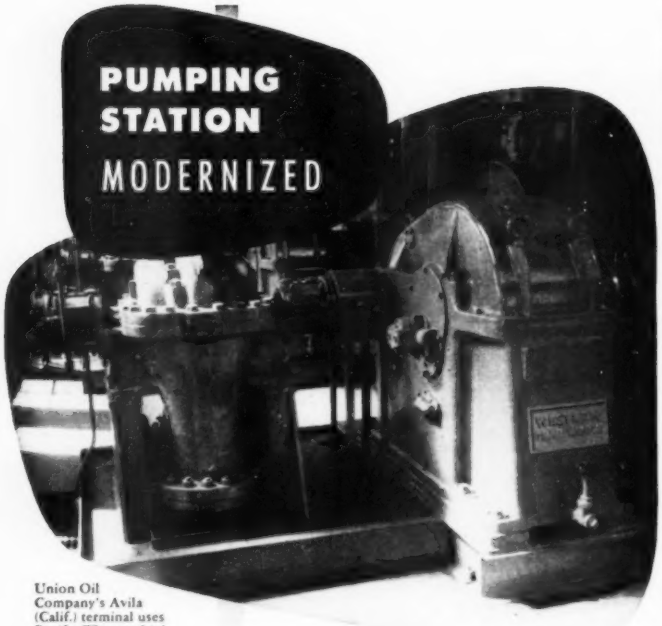

Union Oil Company's Avila (Calif.) terminal uses Pacific-Western high-speed units to step up 450 rpm from the Diesels to 1780 rpm to the pumps.

PACIFIC-WESTERN
High-Speed Units Installed

Modernization of Union Oil Company's Avila terminal and expansion of its capacity to 20,000 bbl per hour has resulted in reduction of tanker loading time by one third, with a fuel saving of 80 to 90%.

A feature of the modernization was the installation of dual-fuel Diesel engines to operate centrifugal pumps. The required speed increase was obtained efficiently through the use of Pacific-Western high-speed gear units.

A typical Pacific-Western high-speed unit for pumping installations. All lubricating-oil and heat-exchanger piping is protected by enclosure within the case. Temperature and pressure indicators are conveniently grouped on an instrument panel. The oil pump is mounted on the outside for easy accessibility.

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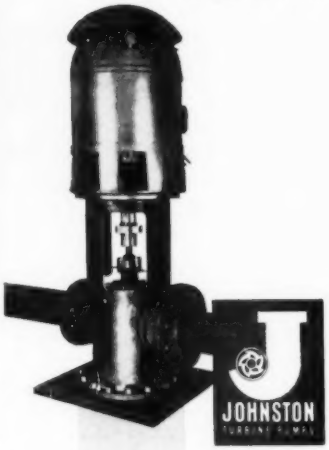

Tough specifications to meet...sure, but the new Johnston Vertical Turbine Pump designed to handle volatile liquids and liquids near the boiling point does it without even breathing hard... Proven performance in the refineries of several large oil companies is a matter of record.

This unit, which has the pump bowls enclosed in a sealed steel barrel, takes suction sufficiently above the pump bowls to give the required net positive suction head. The discharge can be at the same level as the suction or higher if necessary. Where there is a limited net positive suction head, such a unit offers many advantages:

1. The supply vessel can be located wherever convenient and the pump bowls then set low enough for proper submergence.
2. Driver and piping connections are at the surface, eliminating dry sumps which are costly to build and expensive to maintain.
3. Nothing to lubricate but driver bearings.
4. Vertical design needs only ⅓ as much valuable floor space.
5. Due to diffuser type construction, this unit has higher efficiencies than conventional centrifugal pumps at high heads.

Technical papers on the Johnston Volatile Liquid Pump are available. Send for as many copies as you need for interested personnel.

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Among the

Drilling Contractors

Slight Decrease Reported In Number of Active Rigs

The over-all upward trend in drilling activity which has been evidenced in the United States and western Canada the past month was interrupted during the week ended March 13 when a small decline was reported in the number of rotary rigs in operation. The number of rigs running in these regions on the latter date totaled 2,038 as compared with 2,042 reported the previous week. The total for the United States alone increased slightly but the gain in this region was more than offset by a decline in the number of rigs operating in western Canada. A noticeable pick-up in activity was noted in the Gulf Coast area, where a sharp decline had been reported the previous week. However, the increase in the latter area was offset by an equivalent decline in activity in the Arkansas-North Louisiana and East Texas area.

ROTARY RIGS IN OPERATION*

(United States and Western Canada)

Area	Week ended 3-13-50	Change week ended 3-6-50	Change week ended 3-14-49
Gulf Coast	491	+16	—115
W. Tex.-N. M.	698	— 9	+170
Ark.-N. La.-E. Tex.	131	—16	— 8
Oklahoma	251	+ 3	— 7
Kansas	126	+ 9	+ 51
Illinois-Eastern	81	+11	— 13
Rocky Mountains	63	— 1	— 35
Pacific Coast	126	— 8	— 55
Total United States	1,967	+ 5	— 12
Western Canada	71	— 9	— 8
Total	2,038	— 4	— 20

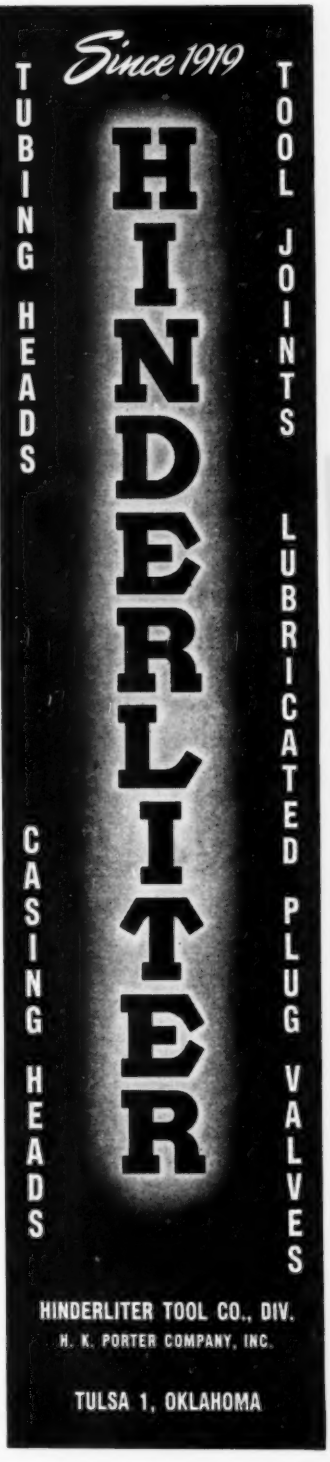
*Courtesy Hughes Tool Co.

M. J. Delaney Drilling Co. was to drill deeper at R. J. Caraway and A. V. Erwin 1 J. L. Mullinax, located in the G. B. King Survey, 1 mile southeast of Winnsboro in northeast Wood County. The well was temporarily abandoned last month at

Attendants at a recent joint meeting in Dallas of the Research and Education and Rotary Drilling Equipment committees of the American Association of Oil Well Drilling Contractors. Standing, left to right: Brad Mills, association executive vice president; William F. Schmeling, Fort Worth, and Howard Texter, Tulsa, Spang-Chalfant division, National Supply Co.; F. G. McClintock, The Zephyr Corp., Tulsa; D. C. Neely, Spang-Chalfant, Houston; Frank L. Thompson, Thompson-Carr, Inc., Midland, Tex.; C. C. Brush, Spang-Chalfant, Houston.

Seated, back row: C. W. Alcorn, Falcon Seaboard Drilling Co., Houston, chairman, Rotary Drilling Methods committee; A. W. Thompson, Thompson-Carr, Inc., Houston, chairman, Research and Education committee; B. R. Scharbarum, Carl B. King Drilling Co., Midland, chairman, Rotary Drilling Equipment committee; E. E. Rubac, American Iron & Machine Works Co., Oklahoma City; U. M. Stewart, Farley Machine Co., Hays, Kans.

Seated, left to right, front to back: L. E. Garfield, Hughes Tool Co., Houston; B. E. Groenewald, Exploration Drilling Co., Tulsa; E. R. Woodmamsee, Hughes Tool Co., Houston; J. C. Jennings, Jennings Drilling Co., Wichita Falls, Tex.; W. F. Behrhorst, American Iron & Machine Works Co., Fort Worth; Kye Trout, A.A.O.D.C., Dallas; Edwin Ross, Baash-Ross Tool Co., Houston; J. B. Hughes, Hydril Co., Houston; Lloyd E. Tracy and F. M. Maier, Oil Well Supply Co., Dallas; W. L. Childs, Jr., W. E. Scarborough, and Wiley B. Noble, Reed Roller Bit Co., Houston; and V. S. Harlin, American Iron & Machine Works Co., Oklahoma City.



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6,704 ft. in the upper Glen Rose. It had porosity in the Paluxy from 6,604-40 ft., but no oil shows. The new objective is the Rodessa expected around 8,500 ft. Derrick was on location at last report. Humble Oil & Refining Co. and Stanolind Oil & Gas Co. were said to be supporting the new work.

Portable Drilling Co. has been awarded contract by Midstates Oil Corp. for a northeast diagonal offset to the discovery well of a new oil pool southeast of Moore in Cleveland County, Oklahoma. The test is 1 Trimble, SE SW NW 29-10n-2w.

Morrison Drilling Co., Eldorado, Kans., is contracting a wildcat test for J. P. Gaty at 1 Borg in 25-26-2e, Sedgwick County, central Kansas.

Sabine Drilling Co., Shreveport, got the contract for a new well which Magnolia Petroleum Co. is starting in the Yantis field, Wood County, East Texas. The well is 1 Alexander Unit, in the Jesse Walker Survey A-607.

Ingram Drilling Co., Wichita Falls, Tex., has contracted to drill a 1,000-ft. test for Mervin L. Friedman of Oklahoma City in 36-7n-20w, about 10 miles northwest of Hobart in northwestern Kiowa County, Southwest Oklahoma. Location of the test, 1 Everhart, is about a half-mile southeast of a recently completed shallow sand discovery well.

Mohawk Drilling Co., Oklahoma City, has contract for a Wilcox test in the East Bearden area of Okfuskee County, Oklahoma, for Davidor & Davidor. The test is 1 Ethel Curry, SW SW NE 14-10n-9e, ¼ mile east of the East Bearden pool. It will test the Wilcox, which was not penetrated by two wells drilled in the area earlier. Mohawk 1 Foster, SE SW NW 14-10n-9e, opened the pool in December 1948.

Duke & Wood Drilling Co., Great Bend, Kan., has a string of tools running for Sohio Petroleum Co. on a wildcat test at 1 Roda, in 7-12-14, Russell County, Kansas.

A. W. Eggleston, Inc., has spudded the American Republics Corp. 22 Columbia Land & Timber Co., Yegua sand test in the Bancroft field, 21-6s-13w, Beauregard Parish, La.

Circle Drilling Co., Lake Charles, La., is drilling Shell Oil Co. 2 Industrial Lumber Co., 6,750-ft. test in the DeQuincy field, Calcasieu Parish, Louisiana. Location is in 2-8s-11w.

Yoakum Drilling Co. is the contractor on a wildcat test (1 Drake) being started 10½ miles west of Jefferson, in Marion County, East Texas, by Olen C. Billingsley. Hole is contracted to 3,700 ft. Location is in Block 20, M. H. Ussery Survey.

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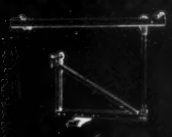

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Exploration and Drilling

Exploration Societies' Convention

THE general program and arrangements of the joint meeting in Chicago next month of the three professional societies dealing with exploration are falling into final shape and some forecasts are possible.

The most important is that all indications point to a record-breaking attendance. As of the middle of March, advance hotel reservations had passed the 3,000 mark, for a convention to be held the last week in April. Never before at a comparable date have registrations been this high. Furthermore, consideration should be given to the fact that because of the hotel capacity in Chicago, there is less pressure to make early reservations. A last-minute arrival has a much better chance of getting reasonably good accommodations in Chicago than in any of the other convention cities.

The general impression previously had been that there might be some falling off in attendance because of the less central location. So, why this change?

The best guess is a combination of unusually strong programs for all three societies, plus the magic word "reef." The honor spot or "top billing" for a joint problem is the Tuesday afternoon joint session when all members of all three societies hold one big meeting. This year the symposium on reefs will be held then. It is a safe bet that there won't be any empty chairs at that session.

Nor will that be the end of "reef talk" at the convention. In the halls, lobbies, in private rooms, and anywhere and everywhere two or more exploration men get together, there will be more talk about reefs. Nearly everybody either has some ideas or wants to talk to someone who has ideas about reefs. Both geologists and geophysicists know quite well that reefs are not a rare geological phenomenon confined to West Texas. The searching of geological literature during the past year has tipped many a geologist and geophysicist off to reef possibilities in many other parts of the United States. There will be a lot of comparing of ideas and swapping of literature references.

But in addition to the reef discussion, there will be two other special symposiums, both of which will partially overlap reefs, and either of which would ordinarily be considered a star attraction. These are the symposiums on "Trapping Components" and revision of "Possible Future Oil Provinces of the United States and Canada." The now nearly 10-year-old report of the A.A.P.G. on "Possible Future Oil Provinces of the United States and Canada" proved to be a remarkably good guide for the petroleum industry. A mere suggestion and a few feelers put out a year ago brought quick response showing that the exploration scientists were eager to see a new report brought out.

The task has been handled in the same fashion as the original success, parceling out responsibility to committees in the various parts of the country. At this symposium the committees will present their 1950 versions of the possible future oil provinces in the various areas. There will be a preliminary session on Tuesday night, and then all day Thursday will be devoted to this project. There won't be many empty seats at these meetings either.

Closely related to both possible future oil provinces and reefs will be a new symposium on trapping components. This is an important, but complex, subject which quite possibly has never had the group attention and attack technique applied on the scale it should. It is difficult to forecast just how much progress this first group attack will make. It could easily bring out some very vital points; and even if they applied only to a few areas, the results could be something no operator in that area could afford to overlook. So, there will be a lot of exploration men in attendance at the Wednesday morning session of the geological meeting to see what develops.

With so many people involved on committees, programs, symposiums, etc., the grapevine gradually spreads the word around about various special attractions, long before the formal program crystallizes. With the emphasis now on finding oil but finding it at a lower cost, and the magic word "reef," sending large numbers of men to this particular convention seems to be striking a lot of companies as good economics.

Charles J. Deegan.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

ROCKY MOUNTAIN AREA.—Continental Oil Co. is preparing to complete its discovery in the Meadow Creek area, Johnson County, Wyoming. Gas and a slight amount of oil was found in the first Wall Creek sand by Phillips Petroleum Co. at its south extension to Glenrock field, Wyoming. The California Co. is in or near the pay at its interesting wildcat at Gusher, Utah.

WEST TEXAS.—Commercial production from the Strawn was assured at Lewis T. Lohman 1 J. W. Young, 98-G-W&NW, 11 miles due west of Clairmont in Kent County. After acid treatment, the well flowed at an estimated rate of 500 bbl. of oil daily through 1½-in. opening, and later flowed 9 bbl. on hour through ¼-in. choke under 510 psi. tubing pressure. Fifteen miles southeast of Seminole, Gaines County, Anderson-Prichard 1-A Parmer, 12-317-Parmer CSL, flowed oil through drill stem from perforations at 12,218-35 ft. in the Mississippian. The Ellenburger had tested salt water. Warren Oil Corp. 1 Reynolds, 101-25-H&TC, between the Von Roeder discovery and Sharon Ridge Canyon fields, topped the reef at 6,575 ft. minus datum point of 4,293 ft., high to nearest producers. Republic Natural Gas 1 American Republics, 1 mile south of Pegasus field, flowed 120 bbl. of oil an hour through ¼-in. choke from 13,025-13,160 ft., total depth.

PERMIAN BASIN

Tests for Canyon Reef Extensions Inconclusive

MIDLAND—Caroline Hunt Trust Estate 1 J. W. Young, Kent County wildcat 8 miles southwest of Clairemont, in 166-G-W&NW, which was said to have topped the Canyon reef at minus 4,116 ft., was drilling ahead below 6,880 ft. Elevation is 2,088 ft. According to some reports, the well has passed the water table. After entering the reef a core from 6,228-37 ft. recovered 1 ft. of hard lime, bleeding oil from fracture. A core at 6,310-30 ft. recovered 11 ft. of very porous lime.

Four miles southwest of the 1 Young, Ted Weiner and Sohio Oil Co. 1 Alice A. Carriker, 87-G-W&NW, reported top of the reef at 6,728 ft., or minus 4,476 ft. Operators reported a soft section from 6,725-27 ft. and a drill-stem test was attempted but failed due to mechanical difficulties. It was to core ahead and retest.

William Herbert Hunt Trust Estate 1 Girard Trust Co., 98-1-H&GN, in northwest Kent County, found the reef nonproductive and was drilling ahead below 7,297 ft. on an 8,500-ft. contract. On elevation of 2,121 ft., top of the reef was called at 6,855 ft. A 2-hour drill-stem test at 6,873-6,919 ft. recovered 70 ft. of mud and 657 ft. of salt water. Top on an unidentified lime section was reported at 6,971 ft.

L. M. Glasco and Spartan Drilling Co., Dallas, were preparing to move in to location at their 1 Emery Trust, SW NW 39-2-H&GN, near the east Garza County line. The wildcat has been projected to 8,005 ft. to test the Ellenburger. According to field reports, interest in the test has been increased by history of Gulf Oil Corp. 1-B Swenson, which is about 1 mile southwest of location. The 1-B Swenson was drilled to 8,104 ft. then plugged back to 7,400 ft. where it tested the Pennsylvanian through perforations at 7,327-34 ft. It was said to have made up to 150 bbl. of oil in 10 hours, and some opinions hold that lack of knowledge of the reef at the time may have attributed to its being abandoned in February 1940.

The Glasco-Spartan wildcat is also about 1½ miles north of Ted Weiner 1 Swenson.

In Scurry County, L. H. Armer and C. H. Chizum 1 C. M. Lyons, 119-3-H&GN, southeast of production in North Snyder field, picked up lime stringers at 7,085 ft., and drilled to 7,248 ft. A drill-stem test from 7,110-7,248 ft., open 3 hours, recovered 1,080 ft. of heavily oil and gas-cut mud, plus 3,990 ft. of oil and mud-cut water with salty taste. Operators believe the test was in the upper Strawn and were to retest from 7,228-48 ft.

In Midland County, Magnolia Petroleum Co. 2 Roy Parks, Section 10, M. Daugherty Survey, 12 miles north of Pegasus field, recovered oil and gas on a drill-stem test in the lower Permian, believed to be Wolfcamp, from 9,525-9,600 ft. Open 4 hours, gas came to the surface in 14 minutes, with a maximum flow of 962,000 cu. ft. daily, and recovery was 400 ft. of heavily oil and gas-cut mud, plus 270 ft. of slightly oil and gas-cut mud. Flowing pressure was 209 psi. Drilling continued below 9,664 ft.

In northwest Runnels County, a 1¼-mile northeast extension to the Northwest Winters (Fry sand) field was completed at Garland Anthony and G. W. Strake 1 W. P. Lloyd, located 330 ft. from the south and 4,735 ft. from east lines of Section 94, Hattie E. Baggs Survey. Completion was natural, for 1,390.0 bbl. of 45 -gravity oil a day, based on a 2-hour gage through ¾-in. choke from 128 perforations at 4,345-57 ft. in 7-in. casing set on bottom at 4,364 ft. Gas-oil ratio was 980 cu. ft., and flowing pressure on tubing was 220 psi.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCATS

Midland County: General American Oil Co. 1-E Josie Faye Peck, NW NW 21-41-T4S-T&P, 4 mi. NW Pegasus field, TD 13,397 ft., PB 13,311 ft., elev. 2,898 ft., Ellenburger 13,098 ft., flowed 1,055.99 bbl. of 53 -gravity oil a day, 1-in. choke, plus 1 per cent water, from 148 perf. 13,128-13,246 ft., 1,000 gal. acid, GOR 935 cu. ft., CP 375 psi., TP 170 psi., Devonian 11,555 ft., Fusselman 12,480 ft., Montoya 12,555 ft.

Runnels County: William Hamm, Jr., and Fred M. Manning, Inc. 1 Charity Pace, Lela Forsythe Sur. 450, 1½ mi. SE Wingate, TD 5,417 ft., PB 4,520 ft., elev. 2,029 ft., Strawn pay 4,442 ft., pumped 7 bbl. of 41 -gravity oil, 3 bbl. salt water a day.

Scurry County: Castleman & O'Neill 1 Feldman-Pardo, NW SW 651-97-H&TC, 2 mi. SW Cogdell field, TD 6,883 ft., elev. 2,443 ft., reef 6,716 ft., flowed 2,782 bbl. of 42 -gravity oil a day, natural, 1-in. choke, GOR 947 cu. ft., TP 600 psi., CP 900 psi.

Progress Petroleum Co. of Texas 1 O. R. Buffaloe, SE SE 565-97-H&TC, 3 mi. N North Snyder field, TD 6,900 ft., elev. 2,433 ft., reef pay at 6,787 ft., flowed 436 bbl. of 41.5 -gravity oil a day, ⅝-in. choke, GOR 730 cu. ft., TP 320 psi., CP 550 psi.

WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Borden County: R. E. Smith 1 C. V. Thompson, SW SW 102-25-H&TC, about 1 mi. E. Amerada 1 Von Roeder discovery, dry, TD 7,382 ft., elev. 2,323 ft., reef 6,818 ft., 28 ft. low to the 1 Von Roeder.

Crockett County: Humble Oil & Refining Co. 1-B Ala Cox, 39-GG-HE&WT, 7 mi. NE Sheffield, dry, TD 7,410 ft. in dolomite, elev. 2,393 ft., Yates 931 ft., Bushey Canyon 1,802 ft., San Andres 1,908 ft., Ellenburger 7,235 ft.

Mitchell County: William Hamm, Jr., 1 Jessie Miller, SE SW 38-26-T&P, 2 mi. E. Colorado City, dry, TD 7,529 ft., elev. 2,194 ft., lime 7,325 ft., Mississippian 7,422 ft., Ellenburger 7,492 ft.

Pecos County: Norwood Drilling Co. et al 1 State National Bank of El Paso, 7-140-T&STL Sur., S offset to Humble 1 State Bank, 7 mi. SE Seiner Ellenburger field, dry, TD 5,528 ft., elev. 2,607 ft., Simpson 5,520 ft. by samples.

Hunt Oil Co. 22 Elsinore Royalty Co., 97-D-GC&SF, 19 mi. SE Chancellor, dry, TD 1,326 ft.

Reeves County: C. O. Davis 1 B. G. Lee, 10-57-T2-T&P, 4½ mi. W. Tunstill field, dry, TD 3,245 ft., elev. 2,868 ft., anhydrite 1,005 ft., base salt 2,605 ft., top Delaware lime 2,790 ft., sand 2,820 ft.

Runnels County: Hickok & Reynolds 1 R. G. Erwin, W. L. Coulson Sur. 342, 10 mi. W. Ballinger, dry, TD 4,976 ft., elev. 1,754 ft., Capps lime 4,119 ft., Ellenburger 4,034 ft.

T. L. Smith, Jr. 1-A Arch Brookshier, Sec. 129, ETRR Sur., 6 mi. NW Talpa, ¾ mi. E. Price 1 Claude Brookshier, Morrow sand discovery, dry, TD 3,850 ft., elev. 1,853 ft.

Schleicher County: J. S. Abercrombie 1 E. M. Wahlenmaier and W. F. Meador, League 7, Concho CLS, 11 mi. NW Eldorado, dry, TD 8,197 ft., elev. 2,506 ft., Strawn 7,527 ft., detrital 7,553 ft., Ellenburger 7,579 ft.

Scurry County: Burdell Oil Co. 1 Eula Bert Keller, 660 ft. from S. 2,014 ft. from W. lines, 340-97-H&TC, 1½ mi. W. North Snyder field, dry, TD 6,982 ft., elev. 2,426 ft., reef 6,840 ft. by samples.

M. E. Davis and J. Conley Miles 1-A John J. Schattel, NW NW 90-2-H&TC, dry, TD 7,781 ft., PB 7,765 ft., elev. 2,459 ft., Pennsylvanian 7,586 ft., Ellenburger 7,750 ft., 5-8 bbl. oil a day in the Ellenburger.

L. M. Lockhart 1 J. S. Criswell, SE SE 625-97-H&TC, 16 mi. SE Snyder, dry, TD 7,440 ft., elev. 2,185 ft., Pennsylvanian 6,955 ft., reef 7,088 ft., Marble Falls 7,280 ft., Mississippian 7,335 ft., Ellenburger 7,415 ft., no shows.

Terry County: Stanolind Oil & Gas Co. 1 M. B. Sawyer, SE SW 123-T-D&W, 5 mi. S. Brownfield, dry, TD 10,628 ft., elev. 3,310 ft., San Andres 4,750 ft., Spraberry 7,710 ft., brown lime 9,950 ft., tentative Pennsylvanian 10,375 ft.

Tom Green County: Cities Service Oil Co. 1 Washington, League 106, Washington CSL, 9 mi. SW San Angelo, dry, TD 6,478 ft., elev. 1,910 ft., lower Strawn 5,400 ft., Ellenburger dolomite 6,349 ft., had shows of sweet gas 4,960-5,000 ft.

SOUTHEASTERN NEW MEXICO

HOBBS—Eighteen miles east of Roswell, in Chaves County, Honolulu Oil Corp. 1 State, 13-11s-27e, swabbed 128 bbl. of oil plus 27 bbl. of acid water in 4 hours, about the same as the previous week's test. Then after shut in for 12 hours, it flowed 40 bbl. of oil in 2 hours. When the packer was unseated at 6,477 ft., it flowed 38 bbl. of oil in 2½ hours and died.

The Texas Co. 1 Ertel, NE NW 27-16s-38e, 1¾ miles northwest of Devonian production in Knowles field, cored 3 ft. of shale and 3 ft. of limestone and dolomite from 13,243-250 ft. Total depth was 13,310 ft. Operators prepared to drill-stem test the section. Tentative tops were placed in the Woodford shale at 13,200 ft., and the Devonian at 13,260 ft., on elevation of 3,721 ft.

Shell Oil Co. 1 W. V. Lawrence, SE SW 32-17s-39e, northeast of Hobbs field, had total depth at 13,920 ft. in shale and lime, and was to drill-stem test. Top on the Simpson was placed at 13,580 ft., on elevation of 3,646 ft.

SOUTHEAST NEW MEXICO WILDCAT FAILURE

Eddy County: York & Harper 1-X Bear 20-24s-29e, 3 mi. E. Malaga, dry, TD 2,842 ft., elev. 2,977 ft., Delaware lime 2,774 ft., sand 2,835 ft., swabbed 3 bbl. oil, 57 bbl. salt water in 36 hr.

MICHIGAN

Traverse Gas Blows Well In Tuscola County Play

MOUNT PLEASANT—The Elmwood play, Tuscola County, which was opened to Dundee oil development late last year, resumed new interest and possible significant importance this week as C. W. Collin 1 Mullen, SE SE SE 17-14n-10w, logged an estimated 3 to 8 million cubic foot gas pay in the Traverse lime horizon at 1,885 ft., total depth.

The 1 Mullen, which logged Traverse lime unexpectedly high in correlation with the Dundee oil producer nearly ½ mile to the southeast, blew gas and formation cuttings out of control for a period of 79 hours before tubing could be run on a packer and well brought under control. Collin elected to save this well as a gas producer but final completion was being delayed until the gas pay could be gaged. A very slight blow-down was evidenced in the long open-flow period. Traverse lime was picked at 1,880 ft. and gas showed in the total section of limestone drilled.

Drilling machine was moved one 10-acre location east, to the SW SW SW 17-14n-10e, to start another hole scheduled to be drilled to the Dundee as an oil test.

This is not the first test in the Elmwood area to show Traverse gas, but it is the biggest and strongest gas pay yet logged in the district. Fletcher-Leman reported an estimated 1,000,000 cu. ft. pay in a test drilled in the SE NW SE, 21-14n-10e, some ½ mile southeast of the Dundee oil producer. The Fletcher-Leman well was carried to the Dundee and was bottomed out dry in that objective.

Acreage owners in the Elmwood area have agreed to a gas-well drilling pattern in the area with the southeast location on each square 40-acre unit being designated for development of Traverse lime gas.

With the good showing of gas at the 1 Mullen, C. W. Collin announced that he had made a farm-out arrangement with

O'Neal and Fletcher-Leman for a checkerboard spread of approximately 600 acres to the southeast of the discovery oil producer where a new Dundee test will be started immediately in the SE NE NW 27-14n-10e.

MICHIGAN WILDCAT FAILURES

Allegan County, Watson Township: W. Spencer Cook, Inc. and H. L. Wadsworth 1 Peterson, SW SW SW 35-2n-12w, Traverse 1,555 ft., dry, TD 1,560 ft.

Gladwin County, Beaverton Township: Granville C. Berlin 1 Johnson, SE NE NW 26-17n-2w, Dundee 3,824 ft., dry, TD 3,956 ft.

Montcalm County, Pine Township: Moco 1 Welch, SW SW SE 3-11n-8w, Dundee 3,357 ft., dry, TD 3,480 ft.

Newaygo County, Troy Township: M. B. Belden 1 Wendell, NE NF SF 18-16n-14w, Dundee 2,599 ft., dry, TD 2,772 ft.

KANSAS

Western Rice County Gets New Arbuckle Lime Pool

LEWIS DRILLING CO. 1 Schmidt, NE NE SW 4-19-10, western Rice County wildcat, has been completed as an Arbuckle lime producer to open the IXL pool. On final potential tests, it pumped 135 bbl. of oil per day. Arbuckle was cut at 3,308 ft. (—1,552 ft.). Hole is bottomed at 3,335 ft. with 5-in. casing at 3,312 ft., 4 ft. in the top of the pay. Prior to being put on the pump, the well swabbed at the rate of 4 bbl. per hour. A total of 4,000 gal. of acid was used.

The well is about 1½ miles southeast of the Ringwald pool, nearest production, and about 2½ miles northeast of the Rick pool, located on the Rice-Barton County line.

Testing is under way at Jones, Shelburne & Farmer 1 Campbell, NE NE NE 30-15-17, another prospective Arbuckle pool opener, located a mile south of the Wheatland pool, southern Ellis County. Before acidizing, the well swabbed at the rate of 1½ bbl. of oil per hour. Following a treatment of 250 gal. of acid, it swabbed 3 bbl. per hour. After an additional treatment of 500 gal. of acid, it swabbed 8 bbl. per hour. Arbuckle was topped at 3,557 ft. (—1,580 ft.). Total depth is 3,561 ft. with hole open from 3,559 ft.

Franco Central Oil Co. 1 Kortman, SW SW NE 22-12-14, 1½ miles northeast of the Claussen pool, Russell County, swabbed 40 bbl. of oil in the first hour after perforating casing in the latest of a series of swabbing tests in several zones in Lansing-Kansas City lime. Latest perforations are at 3,008-10 ft. Previous tests were with casing perforated at 3,158-61 ft. and 3,068-72 ft., respectively. From the lowest zone, the well swabbed 5 bbl. of oil and 7 bbl. of water per hour. From the second zone, it swabbed 8 bbl. of oil and 12 bbl. of water per hour. Top of the Lansing was logged at 2,961 ft. (—1,161 ft.). Prior to testing the Lansing, hole had been drilled to the Arbuckle. The latter formation topped at 3,275 ft. and drilled to 3,280 ft., proved unproductive. Casing was run to 3,276 ft.

Productive limits of the Rhoades pool, Barber County, have been extended a location northward by Barbara Oil Co. 3-A Page, SW NW SW 15-33-11, which flowed 75 bbl. the first hour through chokes. This is the sixth good well for the pool, opened late last year. Production is from the Mississippian, topped at 4,478 ft. (—3,036 ft.). Casing is at 4,545 ft. with hole open to 4,550 ft.

Promising oil showings have been found in the Arbuckle by Alpine Oil & Royalty Co. at its 1 Rusco, SW SW SE 8-19-12, a wildcat located 6 miles northeast of Great Bend, Barton County. Nearest production is in the North Hammer pool, about 3 miles to the southeast. Arbuckle was cut at 3,417 ft. (—1,550 ft.), and drilled to 3,422 ft. Casing has been cemented at 3,418 ft., 1 ft. in the pay.

KANSAS WILDCAT FAILURES

Barton County: Alpine and Quaker Drilling Co. 1 Hulne, SW SE NW 15-20s-12w, dry, TD 3,458 ft., anhydrite 728 ft., Hoxbar 3,037 ft., lime 3,154 ft., Lansing 3,173 ft., conglomerate 3,418 ft., Arbuckle 3,429 ft.

Butler County: E. H. Adair 1 Freeman, NE NE NW 22-25s-3e, dry, TD 2,830 ft., Lansing 2,035 ft., Kansas City 2,315 ft., conglomerate 2,735 ft., cherty conglomerate 2,767 ft., Mississippi chat 2,769 ft., Mississippi lime 2,779 ft.

Ellis County: Braden Drilling Co. 1 Rohleder, SE SE SE 17-14s-16w, dry, TD 3,465 ft., anhydrite 1,020 ft., Hoxbar 3,125 ft., Toronto 3,142 ft., Lansing 3,173 ft., basal Kansas City 3,406 ft., conglomerate 3,415 ft., Arbuckle 3,439 ft.

Ellsworth County: Heathman 1 Barta, SW NE NE 34-15s-9w, dry, TD 2,757 ft., anhydrite 570 ft., Hoxbar 2,586 ft., Lansing 2,724 ft.

Graham County: Pickerell Drilling Co. 1 Thyfault, NE NE SE 12-9s-22w, dry, TD 3,883 ft., Topeka 3,248 ft., Hoxbar 3,464 ft., Dodge 3,487 ft., Lansing 3,502 ft., basal Kansas City 3,714 ft., Arbuckle 3,843 ft.

Harvey County: D. T. Ingling 1 Glenn, SW SW SW 21-22s-1e, dry, TD 2,974 ft., Kansas City 2,501 ft., basal Kansas City 2,770 ft., Mississippi chat 2,974 ft.

Penguin Petroleum Co., Inc. et al 1 Sheets, NE NW SW 14-24s-1e, dry, TD 3,596 ft., Lansing 2,343 ft., Kansas City 2,535 ft., Burgess sand 2,997 ft., Mississippian 3,011 ft., Kinderhook 3,315 ft., Chattanooga shale 3,375 ft., Misener 3,406 ft., Hunton dolomite 3,410 ft., Maquoketa shale 3,481 ft., Viola 3,493 ft., Simpson 3,515 ft., Arbuckle 3,589 ft.

McPherson County: Westgate-Greenland 1

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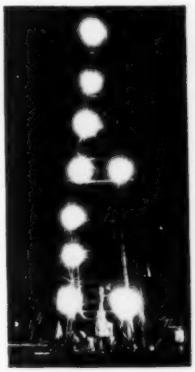

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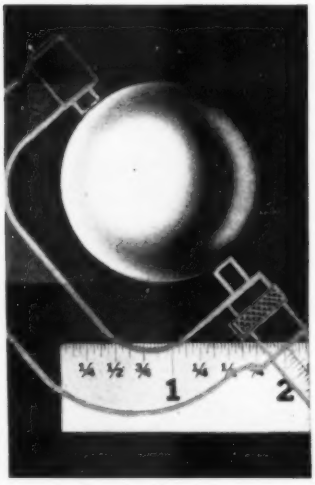

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Cassier, SW SW NE 33-17s-1w, dry, TD 2,728 ft., Mississippi chat 2,684 ft.

Pratt County: Francis Oil & Gas Co. 1 Heizel, SE SE NW 10-26s-13w, dry, TD 4,991 ft., anhydrite 774 ft., Lansing 3,730 ft., conglomerate 4,073 ft., Mississippian 4,177 ft., Viola 4,235 ft., Simpson sand 4,327 ft., Arbuckle 4,441 ft.

Rice County: Heathman Drilling Co. 1 Gray, NW NW SW 32-18s-7w, dry, TD 3,316 ft., Hoxbar 2,629 ft., lime 2,756 ft., Lansing 2,791 ft., conglomerate 3,169 ft., Viola 3,210 ft., Simpson 3,246 ft., Arbuckle 3,306 ft.

Rooks County: Heathman Drilling Co. 1 Schonthaler, NE NE SE 31-10s-19w, dry, TD 3,780 ft., anhydrite 1,546 ft., Topeka 3,172 ft., Hoxbar 3,385 ft., Lansing 3,425 ft., conglomerate 3,670 ft., Simpson 3,728 ft., Arbuckle 3,750 ft.

Sedgwick County: A. D. Allison et al 1 Griffen, SE SE SW 9-26s-2w, dry, TD 3,959 ft., Mississippian 3,468 ft., Kinderhook 3,813 ft., Misener 3,936 ft., Maquoketa 3,937 ft., Viola 3,944 ft., Simpson 3,956 ft.

Stafford County: Birmingham - Bartlett Drilling Co. 1 Spangenberg, NE NE NW 33-22s-12w, dry, TD 3,732 ft., anhydrite 650 ft., Hoxbar 3,154 ft., lime 3,287 ft., Lansing 3,301 ft., Simpson sand 3,691 ft., Viola 3,954 ft., Simpson shale 3,637 ft.

J. J. Lynn 1 Ward, NW SE SW 15-23s-13w, dry, TD 3,896 ft., anhydrite 735 ft., Hoxbar 3,295 ft., lime 3,425 ft., Lansing 3,451 ft., conglomerate 3,710 ft., Viola 3,757 ft., Simpson 3,805 ft., Arbuckle 3,865 ft.

LA.-ARK.

Gulf Well Gives Athens Field New Producing Zone

SHREVEPORT—In Bossier Parish, Gulf Refining Co. 1 Biedenharn, 23-21n-14w, shallow Paluxy wildcat, continued to test a small amount of gas, and a large amount of salt water from perforations in the Nacatoch at 1,005-13 ft. Total depth was 3,200 ft., in the Paluxy topped at 2,420 ft., then plugged back to 2,100 ft.

Sinclair Oil & Gas Co. 1 Oden, 33-19n-13w, new Cotton Valley exploration 5 miles north of Bossier City, had total depth at 4,003 ft. and was running 9-in. casing. On 182-ft. elevation, samples placed base of the annona at 1,720 ft., and top of the lower Cretaceous at 2,560 ft.

Bert Fields 1 Thigpen-Herold, 23-16n-16w, Caddo Parish, cored shale, lime and sandstone with distillate odor from 8,596-8,688 ft., then drill-stem tested from 8,655-88 ft. using 1,000 ft. of water cushion. Thirty-minute recovery was 60 ft. of mud with a slight show of distillate. A core from 8,688-8,773 ft. recovered fine, green sand with shale and distillate odor. A test from 8,740-73 ft. failed on the first attempt.

Barnsdall Oil Co. and others 1 Worley, Claiborne Parish wildcat in 5-22n-8w, was dry at 6,052 ft. Swabbing recovered acid water plus a small amount of oil and gas from Pettit perforations at 5,659-73 ft.

Gulf Refining Co. 1 Kinnebrew, 26-20n-7w, completed for a new producing horizon in Athens field. Completion details were: Elevation 343 ft., total depth 11,513 ft. in the Smackover, with final perforations in the Davis sand of the Cotton Valley formation from 8,148-86 and 8,208-33 ft. Potential was 257 bbl. of 62 -gravity oil a day through 20 64-in. choke, under tubing pressure of 1,860 psi., and with gas-oil ratio at 11,050 cu. ft.

NORTH LOUISIANA WILDCAT FAILURES

Bossier Parish: J. T. Miers 1 C. J. Davis, 7-19n-11w, dry, TD 2,673 ft.

Union Parish: C. M. Bagley 3 Frost Lumber Co., SE NW SE 22-23n-1w, dry, TD 2,538 ft., elev. 204 ft., Midway 1,528 ft., Arkadelphia 2,045 ft., Nacatoch 2,140 ft., sand 2,206 ft.

ROCKY MOUNTAIN

Continental Prepares To Complete Strike

DENVER—Following recovery of oil in the Lakota sand, Continental Oil Co. is now preparing to complete its discovery in the Meadow Creek area, Johnson County, Wyoming. The well is 1 Unit, NE NE NW 11-41n-78w, 2 miles south of the recent Delhi Oil Corp. Sussex sand discovery at North Meadow Creek and 4 miles south of Continental's Sussex pools. The well made 510 ft. of oil and 180 ft. of oil-cut mud in 40 minutes on test between 7,511-28 ft. Top of Dakota was logged at 7,502 ft. by samples. The oil, lighter than that found in Lakota in the Sussex pools, is 43°-gravity paraffin base. A core below 7,528 ft. showed 9 ft. of additional Lakota sand, and at 7,543 ft. Continental was taking another core in Morrison shales prior to completing the well. Since the discovery of oil in this formation at Sussex by Continental in 1948 this area has been of great interest. Production has been somewhat erratic due to complicated faulting through the area. However, Continental now has production in four separate pools, and four pay zones have been established through the various pools. Both Delhi and Continental are undertaking a rapid development program in the area, with 12 rigs running in the 4 pools. Leasing has been active in the area for the past few months and several new wildcats are now scheduled for drilling during the coming year.

Some gas and a slight amount of oil was found by Phillips Petroleum Co. at its south extension in Glenrock field, Converse County, Wyoming. On a 20-minute test of 1 "A" Glenrock, SW NE NE 5-33n-75w, a townsite location, recovery was 100 ft. of heavily oil and gas-cut mud with an estimated 1,000,000 cu. ft. of gas daily. Flowing pressure on the test was 550 psi. and bottom-hole pressure 2,100 psi. The test was made between 5,817-89 ft., and first Wall Creek sand was topped at 5,816 ft. On a test in the second Wall Creek the operator recovered 300 ft. of oil, gas, and water-cut mud in 30 minutes and is drilling ahead for a test of the Dakota. This well is immediately south of the Steelco Drilling Co. Muddy sand discovery, which was recently completed flowing 400 bbl. of oil daily. Steelco is now testing two wells in the field: an east extension to the Phillips' Dakota new pay, and a ¾-mile northeast try. Both are apparent failures in Dakota and Wall Creek sands.

There is considerable interest in developments at The California Co.'s 1 Unit, SE NW NW 35-5s-19e, a tight wildcat in the Gusher area, Uintah County, Utah. The well has been reported at 8,729 ft. for the past 3 days, and reports from Vernal indicate the well may now be in the pay section encountered at Carter Oil Co.-Stanolind Oil & Gas Co.'s discovery 8 miles northwest of Gusher at Roosevelt. The Carter-Stanolind well tested more than 1,600 bbl. of light oil daily from a zone in basal Green River (Tertiary) section at around 9,200 ft. Activities in this portion of the Uintah Basin have increased in recent weeks following location by Carter and Stanolind for a wildcat west of Roosevelt, at Blue Bell, and the operators are moving in for a second well at Roosevelt. The new location at Roosevelt is nearly ½ mile east of the discovery well.

Helmerich & Payne have plugged the first in a series of three wildcats in the Indian Cove area, Owyhee County, Idaho at 3,808 ft., total depth. This well found slight shows of gas at round 700 ft. in Tertiary sands and encountered basalt at around 3,700 ft. The operator is moving in material for its second well in C NW NW 16-6s-7e, 8 miles east of the failure. Following the active wildcat campaign in the Denver - Julesburg Basin, Suhr - Fiedler - Locke plan a wildcat in the CW½ SW SW 31-6n-46w, Phillips County, Colorado. At

its Rosa Unit, Rio Arriba County, New Mexico, Stanolind has made location for a Pictured Cliffs test at 2 Unit, SW SW SE 11-31n-6w.

WYOMING WILDCAT FAILURE

Grieves area, Weston County: Matt Newall 1 Grieves, SW NE SW 14-42n-64w, TD 5,960 ft., dry; Pierre 1,232 ft., Niobrara 4,032 ft., Beaver Creek 4,310 ft., Frontier 4,600 ft., Greenhorn 4,818 ft., Belle Forche, 4,880 ft., Muddy 5,641 ft., Skull Creek 5,658 ft., Dakota 5,845 ft.

IDAHO WILDCAT FAILURE

Indian Cove area, Owyhee County: Helmerich & Payne 1 Parker, SE SE SW 19-6s-8e, dry, TD 3,808 ft.

EASTERN TEXAS

Hydrafrac Gives Carthage Well Good Show of Gas

DALLAS.—Stanolind Oil & Gas Co. 8 Burnett Brothers, Carthage field well in the John F. Cheairs Survey, 8 miles northeast of the Carthage townsite, completed last week as the first well in East Texas to use the Hydrafrac process. According to reports, the well was previously considered nearly dry, but after treatment, rated 1,060,000 cu. ft. of rich wet gas a day from the Travis Peak at 6,057-63, 6,080-88, 6,123-33, 6,187-98, and 6,204-16 ft. Surface pressures were 700 psi. flowing and 1,160 psi. shut in. Bottom-hole shut-in pressure was 2,518 ft. The well was shut in to build up pressure in the Hill sand, for dual-completion attempt.

Atlantic Refining Co. 1 F. L. Landers, E. A. Merchant Survey, and north offset to the company's 1 M. P. Isom, discovery well, had indications of gas production in the Travis Peak. The well has already shown confirmation production in the Young section of the Rodessa, in which the 1 Isom made its discovery. On elevation of 292 ft., the 1 Landers had fair pressures at 7,885-91 and 7,781-93 ft. Further details were not disclosed, but the well was expected to make a dual completion.

A gas blowout at Bobby Manziel 1 Campbell, wildcat test 2 miles south of Tyler in Smith County, was finally brought under control at the end of the week. Blowout occurred Tuesday of last week and by Friday had been capped twice but broke out again. When the crown block was knocked off by an object hurled out of the well, fire started but apparently was quickly snuffed out by the high flowing pressure. The first cap put over the well was quickly blown out, and another and heavier set of valves succeeded in diverting the flow, then closing it in for a short time. Gas pay is from the Paluxy section which had been shot at 7,662-72 ft. Operators had perforated the section and were coming out of the hole when the blowout occurred.

EAST TEXAS (DISTRICTS 5, 6 AND 6-P) WILDCAT FAILURES

Denton County: J. W. Baldwin 1 T. L. Muir, S. Yoachum Sur., A-1440, 2½ mi. SW Sanger, dry, TD 1,920 ft.

Lee Hicks and Stephen G. Pappas 1 Jas. Cowart Ready, M. Rolls Sur., A-1096, 1½ mi. W Sanger, dry, TD 1,690 ft., sand with oil show 1,494-1,502 ft.

M. H. Marr & Ralph A. Bristol 1 E. M. Davidson, J. M. Ruiz Sur., A-1065, 7 mi. SW Sanger, dry, TD 2,515 ft., elev. 821 ft., sand with oil show 2,082-90 ft., recovered salt water on DST.

Nacogdoches County: Sun Oil Co. 1 Mattie Hartless, M. J. Sanchez Sur., 18 mi. NW Nacogdoches, dry, TD 5,077 ft., elev. 345 ft., Nacatoch 3,730 ft., Pecan 3,885 ft., Woodbine 4,875 ft.

Rains County: E. C. Scurlock 1 Lissie Jones, Joseph Simpkins Sur., ½ mi. SW Alba, dry, TD 4,108 ft.

Walker County: L. M. York 1 Jake Billnosky, C. A. Sleight Sur., A-496, 2 mi.

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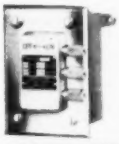

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W New Waverly, dry, TD 3,343 ft., elev. 361 ft.

Wood County: Hollandsworth Oil Co. 1 Geo. W. Foucke Estate, William Dobson Sur., 6 mi. N Hawkins, dry, TD 5,550 ft., elev. 429 ft., Austin 4,752 ft.

TEXAS GULF COAST

Jefferson County Has New Gas-Distillate Discovery

HOUSTON—Meredith, Clegg, and Hunt et al of Houston have completed a new gas-distillate discovery in eastern Jefferson County, approximately 1½ miles southeast of Hillebrandt Bayou field and 3 miles southeast of Lovell's Lake field. The discovery, I Mrs. Euphremia Burrell, flowed gas and distillate through a 3 16-in. choke with no gage made. Production was established through perforations at 8,282-95 ft. After cleaning the well, operators shut it in until potential will be made.

First oil production in the East Sheriff area of Calhoun has been established by Quintana Petroleum Corp. 1 W. Alsup. On state potential, the well flowed 76 bbl. of 42.4 -gravity oil daily through a 5 32-in. choke. Total depth of the well is 9,348 ft., and production is through perforations at 8,113-25 ft. Dual completion is made in a deeper zone gas sand. East Sheriff field has previously produced only gas-condensate. The new oiler is located in the Y Benavides Survey.

A 1,200-ft. south extension to the South Thompson area, Fort Bend County, has been completed at the Cecil Hagen 2 J. H. P. Davis. In addition to extending the field, oil production was found in a new Miocene sand. Flowing through a 10 64-in. choke, the well gaged 125 bbl. of 25.5 -gravity oil daily through perforations at 4,325-35 ft. The well is bottomed at 5,568 ft. The new sander is located in the Robert Peebles Survey.

Henderson Coquat tested gas, a little water, and a very small amount of oil through perforations at 7,287-90 ft. in the 1 Wyatt Curry, wildcat test. AB&M Survey, Abstract 53, Live Oak County. Operator squeezed these perforations and is preparing to perforate a higher section for a gas test.

The 62 new locations include 7 wildcat starts, one each in Calhoun, Karnes, Victoria, Liberty, and San Jacinto counties and 2 in Chambers County. There was one successful exploratory test completed in Bee County, while five were dry, one each in Fort Bend and Wharton counties, and three in Bee County.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCAT

Bee County: New pay and extension of South Plummer—Midstates Oil Corp. 1 Willis A. Roberson, T. B. Barton Sur., A-114, TD 7,059 ft., perf. 6,758-50 ft. (Massive), IP: 22,000,000 cu. ft. gas, open flow, SICP 2,190 psi.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Bee County: Gaylord H. Chizum 1 J. R. Sugarek, W. A. Clare Sur., A-363, ½ mi. W. of Youngeen field, 5 mi. SW of Beeville, dry, TD 4,016 ft.

Clymore & Wyrick 1 C. E. Culpepper, Simon Swyer Sur. 5, A-22, 4 mi. W of Beeville, 3 mi. NW of Youngeen field, dry, TD 5,500 ft.

H. R. Smith, Morris Mizel and Wm. H. Winn, Trustee 1 Edythe Dickinson, Theodora Molina Sur., A-42, 5 mi. SE of Normanna field, dry, TD 3,875 ft.

Fort Bend County: Callery & Hurt 1 John Kasparek, Simon Miller League 2, 4 mi. NE of Boling, dry, TD 3,797 ft.

Wharton County: Johnson & Appling et al 1 Anne Smith, ETRR Sur. 81, 8 mi. S of El Campo, dry, TD 7,815 ft.

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MISSISSIPPI

Showings Found in Wells In Pickens Field Area

JACKSON. — In the Pickens field area, Yazoo County, John Gholson et al 1 James Anderson Estate, 22-12n-2e, is drilling below 7,815 ft. after coring and making a drill-stem test of Lower Cretaceous horizons. First show of oil was noted in core 7,616-24 ft. Drill-stem test at 7,621-27 ft. recovered 95 ft. of salt water with some very heavy black oil in 20 minutes. Second drill-stem tests was of interval of 7,643-53 ft. using 1/4-in. top and 3/8-in. bottom chokes and 930 ft. of water cushion. Tool was left open 20 minutes and recovery was water cushion plus 70 ft. of estimated 26°-gravity oil and 570 ft. of salt water. Bottom-hole flowing pressure was 925 psi. Operators expect to drill to 8,000 ft. and run Schlumberger log.

Also in the Pickens area, Carter Oil Co. has started installing pumping equipment at the 1 J. L. Wilson, 30-12n-3e, Lower Cretaceous discovery which had gone dead. Operators decided to wait until an offset well is cored and tested before attempting to squeeze and rework the 1 Wilson.

Approximately 5 miles northwest of Elisilie field, Adams County, J. D. Reese has run into difficulty in completing the 1 George Armstrong. Casing was perforated in the Wilcox at 6,592-94 ft. and test showed some oil along with salt water for the first hour. During the second hour the well died. Perforations were squeezed and casing was reperforated at 6,593-95 ft. with 8 jet shots in an attempt to get penetration. Tubing was again run on packer and well was swabbed down to 5,000 ft. but would not flow. After waiting 4 hours, the well began to flow and after 8 hours it was put on 1/8-in. choke and turned into tanks. Tubing pressure dropped from 280 psi. to 170 psi. in 7 hours. Testing operations will continue.

It is reported that an official spokesman for Humble Oil & Refining Co. stated that several showings of oil had been found in the company's 1 Marion Wall Davies, 15-3n-2e, Clarke County, Alabama. Drilling is still under way at the well. Depths of the oil shows were not released.

MISSISSIPPI WILDCAT FAILURES

Adams County: Humble Oil & Refining Co. 1 Hyde R. Jenkins et al, 19-5n-3w, dry, TD 8,000 ft.

Jefferson County: Red Wing Drilling Co. 1 R. D. Walser, 27-8n-1w, dry, TD 6,520 ft.

Lamar County: La-Grange Petroleum Co. 1 Frank Egloff, 17-3n-16w, dry, TD 9,650 ft.

GEORGIA WILDCAT FAILURE

Seminole County: Mont Warren 1-A Grady Bell, Land Lot 61, 27th Land District, dry, TD 3,806 ft.

SOUTH LOUISIANA

Shows Found in Iberia And Beauregard Parishes

NEW ORLEANS. — Magnolia Petroleum Co. is testing gas-distillate in its C-1 Long Bell well, wildcat venture 2 miles south of Dry Creek townsite in Beauregard Parish. Through a 1/8-in. choke, the well tested 46 bbl. of 61.2°-gravity distillate with 2,175 psi. pressure on the tubing. The well is bottomed at 9,850 ft. and testing is through perforations at 8,468-72 ft. Operators will continue to test the venture.

Productive sand has been found in Gulf Refining Co. 1 Provost Cyr Unit, wildcat, 19-14s-7e, Iberia Parish. The well was drilled to 13,786 ft. and 5-in. liner cemented at 13,590 ft. Casing was perforated at 13,398-418 ft., and through a 10/64-in. choke the well flowed 335 bbl. of oil daily, with a flowing pressure on the tubing of 1,800 psi. The wildcat is approximately 1 1/4 miles southeast of Shell's deep production at Weeks Island.

New pay has been opened in the Black Bay area of Plaquemines Parish with completion of Gulf Refining Co. 5 Louisiana State Lease 195 "QQ." The well is producing 186 bbl. of 39°-gravity oil daily through a 1/8-in. choke with 1,500 psi. flowing pressure on the tubing. The new producer is bottomed at 11,503 ft., has 7-in. casing cemented at 10,500 ft. and is producing through perforations at 10,420-30 ft.

Ohio Oil Co. has drilled to 9,912 ft. in the 1 E. W. Brown, Jr., Calcasieu Parish wildcat, and plugged back to 8,135 ft. for completion attempt. Operator will perforate the second oil sand from 7,790-93 ft. The venture, located in Section 20-11s-13w, is 5 miles northwest of Black Bayou and 6 1/2 miles southwest of Vinton production.

After testing salt water from two series of perforations in the D-1 E. H. Schwing et al, Iberville Parish wildcat, Humble Oil & Refining Co. has resumed drilling and is making hole below 11,535 ft. in hard sandy shale. The well, in 13-10s-10e, has 7-in. casing cemented at 11,505 ft. and operator tested salt water through perforations from 11,416-22 ft. and 11,336-66 ft.

The 17 new locations include 3 wildcat starts, 1 in Vermilion Parish and 2 in Lafayette Parish. There was one successful exploratory test completed in Cameron Parish, while two were dry, one each in Acadia and Iberville parishes.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

Cameron Parish: Gas-distillate discovery, offshore—Magnolia Petroleum Co. A-1 State Lease 1120, 11-15s-11w, top sand 10,806 ft., TD 10,940 ft., perf. 10,806-14 ft., IP: 27 bbl. condensate plus 3,893,000

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SOUTH LOUISIANA WILDCAT FAILURES

Acadia Parish: W. L. Jamison 1 Andrepont-LeJeune, 42-8s-1w, 2½ mi. NE of Iota, dry, TD 9,520 ft.

Iberville Parish: Sohio Petroleum Co. and Sinclair Oil & Gas Co. 1 Cilano, 12-9s-13e, 2½ mi. SW of Sunshine area, dry, TD 11,111 ft.

CALIFORNIA

Deep Wildcat Staked In Fresno County

LOS ANGELES.—General Petroleum Corp. is preparing to drill a deep test 15 miles east of East Coalinga field. Location has been staked for 11 Boston Land Co. near the center of 14-20s-18e in the Huron area of Fresno County. The well will attempt to find a productive sand of Eocene age, and will probably go below 11,000 ft. An interesting aspect of the test is that The Texas Co. drilled a wildcat ½ mile to the northeast, the 1 Boston Land Co., 10 years ago with the same objective, but the project had to be abandoned at 10,747 ft. when drill-pipe fish at the bottom of the hole could not be recovered. The McClure shale was found in this well at 8,496 ft. and the Temblor at 10,290 ft., the latter being the principal productive horizon at Kettleman Hills to the southwest. Major production in East Coalinga field is from the Gatchell sand of Eocene age. Whether The Texas Co. wildcat went through the Temblor was not revealed, but it seems unlikely. In any event no oil was found and no other deep test has been drilled for many miles in any direction.

Continental Oil Co. is attempting to establish commercial production in a new deep sand in San Miguelito field, Ventura County, at its 65-E Grubb, 25-3n-24w. Twelve hundred and six feet of blank liner has been landed at 15,775 ft. and tests will be made by stages. If successful, this well could become deepest producer in world, surpassing Standard Oil Co. of California's 5 Mushrush in the Wasco field, Kern County, California, which is producing from 15,530 ft.

Superior Oil Co.'s 18 Government wildcat in 2-11n-28w, 3 miles northwest of Russell Ranch field in the Cuyama Valley remains in doubt this week. The only work done in the last 7 days was to core 109 ft. of hole and all scout reports agree that the company has made a new discovery. Hancock Oil Co. is going ahead with 65 Clayton, wildcat ½ mile to the southwest in Section 10, and will spud this week. Hancock has half interest in this well, with Mohawk Petroleum Corp. and Oceanic Oil Co. each holding a quarter interest.

Douglas Oil Co.'s 85 Cuyama, wildcat in 16-9n-26w, 2½ miles southeast of South Cuyama field is spot coring near 7,000 ft. in the best shale body found to date and there is some revival of interest in its prospects. Leasing activity and wildcat drilling are at new highs throughout Cuyama Valley with an increasing number of operators getting into the play.

CALIFORNIA WILDCAT FAILURES

Los Angeles County, Val Verde area: Bolsa Chica Oil Corp., British-American Oil Producing Co., and Humble Oil & Refining Co., 1 Strawn, 10-4n-17w, dry, TD 9,435 ft., elev. 1,354 ft.

Santa Carbara County, Cuyama Valley area: Seaboard Oil Co., 1 Kirschenmann, 7-10n-26w, dry, non-Marine Pliocene 3,685 ft., Santa Margarita transition, 4,902 ft., Santa Margarita 5,218 ft., lower Miocene shale 6,501 ft., Painted Rocks sand 6,715 ft., Colgrove equiva-

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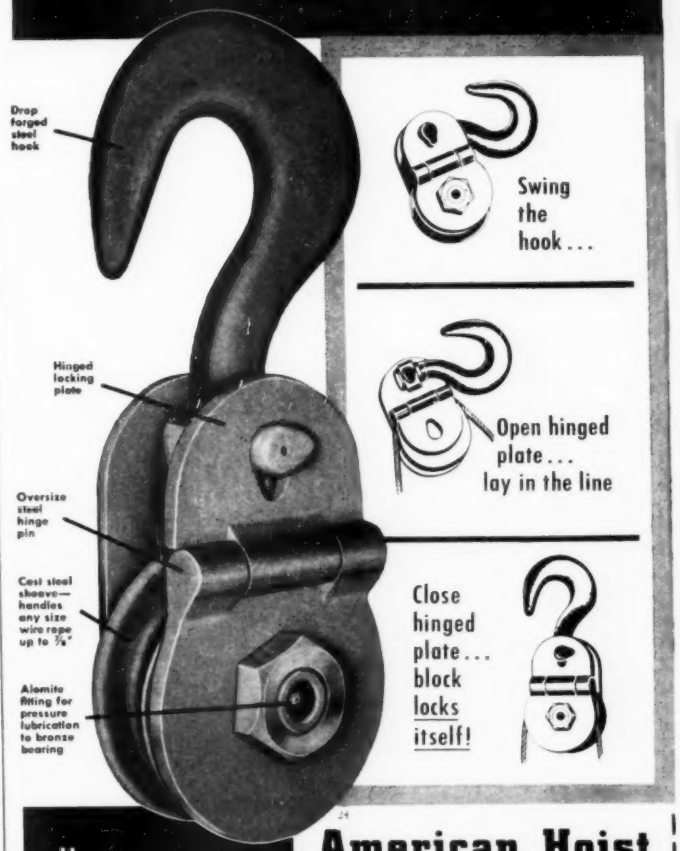
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lent 7,562 ft., Cretaceous 7,646 ft., TD 7,788 ft., elev. 2,050 ft.

Kern County, Tejon Hills area: O. M. Slosson, 1 Reservoir Hill, 32-11n-18w, dry, Santa Margarita 606 ft., Basalt 1,222 ft., gray sand, 1,032 ft., TD 1,242 ft., elev. 1,002 ft.

Fresno County, Kerman area: Elmer C. von Glahn, 1-62-22 Kerckhoff, 22-14s-16e, dry, Kreyenhagen 5,381 ft., Surfluh sand 5,618 ft., Domengine 5,723 ft., Cretaceous 5,810 ft., Wheatville sand 5,990 ft., TD 6,262 ft., elev. 187 ft.

CALIFORNIA SUCCESSFUL WILDCAT

Los Angeles County, Del Valle area: Southern California Petroleum Corp., 1 Kinler, 16-4n-17w, ¼ mi. N of Del Valle field, elev. 1,185 ft., flowed 182 bbl. 22 - gravity oil a day, 0.5 per cent cut, 28 64-in. choke by heads from Del Valle zone, will install pump, TD 7,664 ft.

OKLAHOMA

Oil Showings Found In Woods County Wildcat

OIL showings have been found in a rank wildcat test, located in northern Woods County, northwestern Oklahoma. The test is Harper & Turner 1 Williams, NW NE SW 31-29n-15w, 2 miles south of Yellowstone and about 4 miles south of the Kansas line, across from Barber County. Showings were in the Mississippian, topped at 5,084 ft. A drill-stem test, taking in an interval at 5,079-5,100 ft., yielded 430 ft. of oil-cut mud. Hole is being deepened to its objective, the Simpson sand, expected around 6,400 ft.

A deep wildcat test located ¾ mile south of the Sholem Alecheem pool, Stephens County, southern Oklahoma, is giving indications of possible good production in the Springer C-1 zone. The test is Stanolind Oil & Gas Co. 1 Thacker, SW NW NW 25-1s-4w. It topped the Springer section at 4,761 ft., and the Springer C-1 interval at 5,635 ft. Coring at 5,642-61 ft., it recovered 18 ft. and 8 in. of fine-grained saturated sand. A core at 5,661-75 ft. yielded 12 ft. 4 in. of saturated sand. Additional cores from 5,675 to 5,727 ft. recovered 27 ft. of saturated sand and 25 ft. of hard white sand without saturation.

Promising showings previously had been found in shallower horizons. A drill-stem test at 3,945-73 ft. recovered 120 ft. of oil-cut mud (50 per cent oil), 100 ft. of free oil, and 20 ft. of water. Another test at 4,354-64 ft. resulted in a recovery of 450 ft. of oil and 30 ft. of mud.

W. E. Steelman 1 Baldwin, SE NE NE 34-1n-1e, which is opening a new pool 3½ miles west of Davis, Garvin County, is being put on the pump after swabbing tests in which it made 60 bbl. of 34° oil in 24 hours. Production is from Deese sand at 2,490-2,542 ft. The discovery is about 2½ miles southeast of the Northwest Hoover pool and about the same distance south of the Northeast Buttery pool. It is on a California Co. farm-out and near a 7,505-ft. dry hole drilled by the latter company.

Production of the Northeast Elmore pool, Garvin County, has been extended southwestward into the Elmore townsite at Kerr-McGee Oil Industries, Inc., 1 Elmore Townsite, Lot 2, Block 10, SE NW SW SE 22-2n-2w. Testing both the upper and lower Gibson sands, opposite which casing was perforated at 6,681-95 ft., 6,751-59 ft., and 6,738-46 ft., the well flowed 5.65 bbl. of oil per hour through 13 64-in. choke. Hole had been drilled to 6,889 ft., and 5½-in. casing cemented at 6,886 ft.

OKLAHOMA SUCCESSFUL WILDCATS

Carter County: Turner 1 Williams, NE NE NW 16-5s-1w, pumped 80 bbl. of 35.3 - gravity oil per day from limy sand at 3,876-3,904 ft., TD 4,597 ft.

Creek County: Mitchell et al 1 Stone, SW SW SW 6-17n-9e, pumped 5 bbl. of oil per day from Burgess at 3,026-40 ft., TD

OKLAHOMA WILDCAT FAILURES

Comanche County: McCain & Co. 1 Miller, NW SW SW 27-2n-11w, dry, TD 525 ft.

Cotton County: Hutcheson 1 McClung, SW SW NW 20-2s-11w, dry, TD 2,477 ft., Megargle 2,360 ft.

Grant County: Campbell 1 Eberly, NW NW NE 33-28n-3w, dry, TD 812 ft., shale 767 ft., hard lime 773 ft.

Greer County: Schulte et al 1 Windle, SE SE NE 23-5n-21w, dry, TD 506 ft. in shale.

Watts et al 1 Iron, NE SW SW 29-6n-22w, dry, TD 770 ft. in red beds.

Hughes County: Pecan Grove area—King et al 1 Lowrance, NW NW NE 20-8n-9e, dry, TD 3,451 ft., coal 1,262 ft., Senora lime 1,355 ft., Red Fork 1,900 ft., Red Fork sand 1,920 ft., Inola 2,190 ft., Bartlesville 2,235 ft., Bartlesville sand 2,270 ft., lime 2,525 ft., Booch 2,663 ft., lower Booch 2,739 ft.

Kay County: Wyoming Oil & Drilling 1 Woolsey and Rogers, NE NE NW 22-28n-1w, dry, TD 3,436 ft., lime 2,790 ft., Layton 2,840 ft., Oswego 3,090 ft.

Kiowa County: Granite area—Ross 1 Fleppin N 2 SE NW 30-7n-20w, dry, TD 1,260 ft.

Lincoln County: Gulf Coast Western 1 Stephens, SE SE NE 12-16n-4e, dry, TD 4,528 ft.

E. Parkland area—Kemp et al 1 Haskin, NE NE SW 21-16n-5e, dry, TD 4,440 ft., Oswego 3,358 ft., Prue 3,430 ft., Verdigris 3,648 ft., Skinner 3,690 ft., Inola 3,782 ft., no Bartlesville, lime 3,906 ft., Mississippi lime 4,016 ft., Woodford 4,210 ft., Hoxbar 4,234 ft., Sylvan 4,242 ft., Viola 4,324 ft., Wilcox 4,381 ft., second Wilcox 4,424 ft.

Noble County: Sinclair 1 Sullins, SW SW NE 12-23n-1w, dry, TD 4,579 ft., Avant 3,681 ft., Osage-Layton 3,427 ft., Layton 3,990 ft., Checkerboard 3,894 ft., Oswego

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3,994 ft., Verdigris 4,230 ft., lower Skinner 4,302 ft., lime 4,336 ft., no Bartlesville, Mississippi chat 4,562 ft., Mississippi lime 4,570 ft.

Pawnee County: Lauderdale area—Puls et al 1 Rowe, NE NE SE 15-20n-8e, dry, TD 1,724 ft.

Woodward County: H. E. R. Drilling et al 1 Ferguson, C NE NE 29-24n-21w, dry, TD 7,639 ft.

APPALACHIAN FIELD

West Virginia Test Finds Oriskany Dry

PITTSBURGH.—In Tucker district, Wirt County, West Virginia, Godfrey L. Cabot, Inc. 1-1317 Thomas Hughes was completed at 5,424 ft., resulting in salt water at this depth; Corniferous lime 5,274 ft., Oriskany sand 5,409 ft. United Fuel Gas Co. 6550 T. S. Counts topped the Corniferous lime at 5,138 ft. and is drilling at 5,188 ft. In Steele district, Wood County, Columbian Carbon Co. 1140 F. B. Allman et al is drilling at 5,291 ft. in the Oriskany sand which was topped at 5,240 ft. In Portland district, Preston County, Snee & Eberly 2 Cora E. Lewis encountered a bad hole and now cleaning out at a depth of 5,659 ft. after shot. In Lincoln district, Wayne County, E. C. Ware 6 United Fuel Gas Co.-Moses Fork gaged 1,555,000 cu. ft. of gas in the brown shale, total depth 3,243 ft. Frank Yates 3 Caldwell & Colton tested 924,000 cu. ft. of gas in the salt sand, total depth 908 ft.

In South Strabane Township, Washington County, Pennsylvania, United Drilling Co. 1 John Schrontz was brought in, estimated at 20 bbl. of oil per day in the fifth sand, completed at a depth of 3,018 ft. In Unity Township, Westmoreland County, Peoples Natural Gas Co. 3921 Fred Musnug is building rig. This company's 4-3814 Camilla Giffen, Derry Township, has resumed drilling. In Napier Township, Bedford County, South Penn et al, Snee & Eberly 1 Jesse B. Miller, elevation 1,666 ft., is drilling at 7,050 ft.

WEST VIRGINIA WILDCAT FAILURE

Wirt County, Tucker district: Godfrey L. Cabot, Inc. 1-1317 Thomas Hughes, elev. 1,051 ft., dry, Corniferous lime 5,274 ft., Oriskany sand 5,409 ft., salt water 5,424 ft., TD 5,424 ft.

CANADIAN FIELDS

Shows Found in Madison Northwest of Edmonton

CALGARY.—Further encouragement has been shown in the Madison limestone at O'Meara Canadian Drilling Co. 2 Barrhead on the north central Alberta plains, northwest of Edmonton. After recent acidization and swab test the well showed a 700-ft. rise of fresh water which is believed to be input water and 300 ft. of clean oil.

The 2 Barrhead, LSD 7, 9-59-5w5, completed at 3,914 ft. Casing was set to bottom and perforated from 3,891-3,906 ft. A 200-gal. acid treatment was applied and the well was swabbed dry. The 1,000-ft. fluid rise was then obtained. Crew has now jet perforated the interval 3,895-3,907 ft. with a further 44 shots and is preparing to re-acidize with 2,000 gal. prior to swabbing.

The 2 Barrhead is O'Meara's second well on farmout blocks from the team of Standolind Oil & Gas Co. and Imperial Oil, Ltd. First venture, around 5 miles south of No. 2, completed with a substantial potential of 22° to 24°-gravity crude oil from the Madison lime.

Canadian Gulf Oil Co., Alberta operating unit of Gulf Oil Corp., has staked more follow-up well locations at its two key discoveries—Pincher Creek, in the southwest corner of Alberta; and Stettler, on the south central plains. Four new sites have been staked, three at Stettler, one at Pincher.

The new Pincher Creek test, fourth for Gulf in the area, will be Canadian Gulf 1 A. Bonertz, to be drilled in LSD 1, 15-4-29w4. It will go down in the 7-mile stretch separating Gulf's two $2^1/_4$-mile-deep "wet gas" wells, and is designed to further evaluate the major Pincher wet gas field and prepare that field for the opening of a market for its reserves. The site is about $4^1/_2$ miles north-northwest of the Pincher Creek discovery well, and about $2^3/_4$ miles southeast of Gulf's 1 Walter Marr follow-up success. Gulf's third Pincher completion, 1 Fred Shrempp, which looked for an oil accumulation down the plunging west flank of the Foothills structure, was abandoned some weeks ago after getting salt water and no commercial volume of wet gas.

The three new Gulf Stettler sites are all quarter-mile offsets of current production.

The Campbell area, about 10 miles northwest of Edmonton, has rated its second Lower Cretaceous oil well, and a third venture has commenced drilling.

The new oil well, Redwater Leaseholds 2 Campbell, LSD 8, 28-54-25w4, $^1/_4$ mile north of the discovery well, completed at 3,750 ft. and was placed on a short pump test. During the 1 hour and 40 minute test the well pumped 33 bbl. of crude oil, a rate considerably higher than would be expected if a 24-hour run was made. No. 2 well appears to be a better producer than the discovery, and it is believed that the

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well would probably make around 70 bbl. daily on steady pump. Potential test has not as yet been run.

The 3 Campbell, second in a series of four wells to be drilled by the Northern Development Co.-Redwater Leaseholds, Ltd., team has been spudded in LSD 5, 27-54-25w4.

Twenty-one wells were completed by the oil industry in Alberta during the past week, 12 field development producers and 9 exploratory dry holes. This is a record for any one particular week since the beginning of the year, and boosts total completions for 1950 to 124, for the period January 1 to March 17. Included in the list are 84 oil wells, 5 gas discovery wells, and 35 dry holes.

Last week brought eight more oil wells to the Redwater field, four at Leduc, and nine exploratory dry holes. Three of the exploratory tests were only temporarily abandoned due to their location in the northern muskeg country of Alberta and the spring thaws approaching. The completion count for the year now stands: Redwater, 53 oil wells and 1 failure; Leduc, 24 oil wells and 3 failures; Excelsior, 3 oil wells and 2 failures; Stettler, 2 oil wells; Golden Spike, 1 oil well; Turner Valley, 1 oil well; 5 gas discoveries; and 29 exploratory dry holes.

CANADIAN WILDCAT FAILURES

Tracy 1 Lac La Biche, LSD 5, 27-68-11w4, TD 1,696 ft.

Time 1 Texaco-Brightbank, LSD 4, 28-51-2w5, TD 7,168 ft.

Stanolind 1 Smoky Lake, LSD 12, 9-61-17w4, TD 3,200 ft.

Gulf 14 H. W. Kerridge, LSD 14, 14-37-20w4, TD 5,558 ft.

American Leduc-Yankee Canuck 1 Tees, LSD 13, 23-41-23w4, TD 5,886 ft.

Shell 1 Muskwa, LSD 14, 34-84-24w4, TD 3,008 ft.

Shell 2 Muskwa, LSD 4, 2-85-7w5, TD 2,881 ft.

Shell 3 Muskwa, LSD 3, 5-85-3w5, TD 3,146 ft.

Royalite 1 Ghost Pine, LSD 12, 36-30-22w4, TD 6,190.

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SOUTHWEST TEXAS

Potential Run on Brooks County Discovery Well

CORPUS CHRISTI.—H. L. Hawkins has run a potential on the 1 Singer Estate, oil-field discovery 23 miles southwest of Falfurrias, Brooks County. The well flowed 112 bbl. of oil through a 3/16-in. choke on initial test through perforations at 4,005-28 ft. When put back on a ¼-in. choke, the well flowed 70 to 80 bbl. of oil daily with 300 psi. pressure. The new discovery is located in the C&MRR Survey 436.

Taylor Refining Co. and Mayfair Minerals, Inc., have perforated the 1 Roy Barnes, wildcat test 8 miles south of Pharr, and are now testing. The hole is at a depth of 11,611 ft. and 5½-in. production casing is set on bottom. Testing operations are being made at 11,311-11,530 ft.

It is reported that Hewit & Dougherty have picked up 16 different sands in the 1 F. G. Gabriel, 10,000-ft. test in Mud Flats field, Aransas County. The prospective producer is located in Lot 8, Block 48, Sixth Addition Taft Farm Lands Subdivision.

Producers Corp. of Nevada is coring ahead at 6,186 ft. in the 1 E. S. Austin, Gonzales County wildcat test in the J. A. Winn Survey. Electric log and drill-stem test was run on the venture, but no results were reported.

Sunray Oil Corp. has perforated from 7,949-50 ft. and squeezed in the 1 O. W. Killam, wildcat venture 14 miles east of Laredo in Webb County. No details are known as to what was made on the test. Hole is now bottomed at 9,935 ft.

O. W. Killam is drilling below 6,285 ft. with no shows as yet in the 1 Holbein Estate, a 6,500-ft. wildcat 24 miles south of Hebbronville, Jim Hogg County. The test will be drilled to contracted depth, and if nothing is found by log test, the venture will be abandoned.

The 43 new locations include 15 wildcat starts, 1 each in Jim Wells, Duval, San Patricio, Starr, Webb, Atascosa, Bell, Caldwell, Frio, Guadalupe, Medina, and Uvalde counties and 3 in Nueces County. There were 2 successful exploratory tests completed, one each in Brooks and Kleberg counties, while 12 were dry, 1 each in Bastrop, Gonzales, Guadalupe, Travis, Williamson, and Cameron counties, and 2 each in Duval, San Patricio, and Starr counties.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Brooks County: Oil discovery at Alta Verde field—H. L. Hawkins 1 Singer Estate, C&M RR Sur. 436, 23 mi. SW of Falfurrias, top pay 4,004 ft., TD 4,273 ft., perf. 4,003-28 ft., IP: 114 bbl. oil per day 3/16-in. choke, TP 300 psi., 33° gravity.

Kleberg County: Gas-condensate discovery—Humble Oil & Refining Co. G-3 King Ranch-East Laureles, Laguna Larga area, Tract 123, Rincon de Los Laureles Farm Tracts, TD 9,992 ft., perf. 6,030-50 ft., IP: 90,000,000 cu. ft. of gas per day, no distillate gage, 56° gravity, GOR 50,000.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Bastrop County: Ogden B. Klein et al 1 Hiran Walker, C. J. Glasscock Sur., 4 mi. E of Elgin, dry, TD 3,399 ft.

Cameron County: Arroyo Oil Corp. 1 Taylor Bros., State Sur. 278, 6 mi. NE of Harlingen, dry, TD 8,501 ft.

Duval County: Cox and Hamon 1 D. Gottleib et al, B. Elizondo Sur. 570, A-1,839, 8 mi. S of Freer, dry, TD 4,000 ft.

Daubert & Achning 1 Rosa V. De Benevides et al, Block 10, Sec. 19, Mariano Arispe Grant, 4 mi. E of Bruni, dry, TD 3,104 ft.

Gonzales County: Producers Corp. of Nevada 1 E. S. Austin, John A. Winn Sur., 3½ mi. N-NE of Nixon, dry, TD 6,248 ft.

Guadalupe County: Fred C. Whitton and Bernard 1 F. A. Pfullmann, Greene DeWitt Sur. 11, 8 mi. E of Seguin, dry, TD 2,654 ft.

San Patricio County: William Herbert Hunt Trust Estate 1 Emma Herron, 2½ mi. NE of Taft, dry, TD 7,500 ft.

Sam Krasner 1 Chas. R. DeWitt, Sec. 11, Cubage & Miller Subd., 1 mi. E of Edroy, TD 2,005 ft.

Starr County: C. S. Albrecht 2 P. S. de Reynaga, Porcion 110, 2 mi. S of Buena Vista field, dry, TD 1,160 ft.

Southern Minerals Corp. 1 Zaragoza Salinas et al, Z. Salinas Sur. 304, 4 mi. NE of Margo gas field, dry, TD 1,715 ft.

Travis County: H. F. Goff 1 Maggie Burleson, James Gilleland Sur. 13, 2½ mi. W of Webberville, dry, TD 1,874 ft.

Williamson County: George Miskovsky 1 Wittliff, William Lancy Sur., 2 mi. W of Coupland, dry, TD 1,055 ft.

N. CENTRAL TEXAS

Archer County Test Proves Dry in the Ellenburger

WICHITA FALLS—Mid-Continent Petroleum Corp. 1-A R. H. Farmer, Bell County School Land Survey, 6 miles northeast of Megargel in Archer County, was dry at 5,598 ft., in the Ellenburger. The Mississippian exploration recovered only mud on a drill-stem test of that formation at 5,372-93 ft. A drill-stem test in the Caddo from 4,916-23 ft., open 1 hour, recovered 600 ft. of gas, 10 ft. of gas-cut mud, and 3 ft. of oil. Location is about 4 miles northeast of new Caddo production.

Ted Weiner's 1 Olin Calvin, R. Grooms Survey, A-155, Mississippian wildcat 2 miles south of Anarene, had total depth at 5,226 ft. in its objective formation, topped at 5,202 ft. Operators were fishing for tubing dropped in the hole. A drill-stem test from 5,203-26 ft. had gas in 4 minutes and flowing oil in 75 minutes.

In the new unnamed Strawn producing area, 5 miles southeast of Crowell in Foard County, Ard Drilling Co. 1 J. G. Halsell, John Shearer Survey, was dry at 5,510 ft. The area has had some Canyon production, identified as reef, around 3,700-3,800 ft. The 1 Halsell reported Canyon reef top at 3,700 ft., on elevation of 1,414 ft. A drill-stem test of the section from 3,733-3,828 ft., open 1 hour, recovered 1,530 ft. of salt water. Bottom-hole flowing pressure was 450 psi.

In Jack County, Far West Oil Co. 1 I. G. Yates, G. W. Jackson Survey, A-1,120, was drilling in shale and sand at 5,114 ft., on a 6,000-ft. conglimerate contract. Conglomerate with odor was cored from 4,318-24 ft.

Corrected information on Russell Maguire 1 Nannie E. Davis, wildcat 9 miles southeast of Jacksboro in the WCRR Survey, A-501, had conglomerate at 4,644-69 ft., and shaly lime to 4,694 ft. First drill-stem test from 4,636-94 ft., open 60 minutes, recovered 600 ft. of slightly oil-cut mud, under bottom-hole flowing pressure of 250 psi. Operators ran electrical surveys to 5,010 ft. Location is 2 miles northeast of new conglomerate production.

Robert Payne 1 Ira G. Yates, Caddo test 4½ miles southeast of Stewarton in Jack County, Block 2, Henderson CSL, was drilling lime at 5,070 ft. Second drill-stem test of the Caddo at 5,010-17 ft. had gas in 47 minutes. Recovery after 85 minutes was gas and mud.

In Wise County, 3 miles southeast of Cottondale, Akin & Dimock 1 Willie M. Kinsey, J. M. Mora Survey, A-541, was drilling lime and shale at 5,672 ft., following its fifth drill-stem test of the Caddo, at 5,203-23 ft. One-hour recovery was 25 ft. of mud.

In Fisher County Harrigan & Fohs 1 Jameson, Block 1, H&TC Survey, 8 miles northeast of Rotan, was drilling shale and lime at 4,860 ft.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Jack County: F. Kirk Johnson et al 1 Hattie Mae Wright J. W. Bates Sur., A-47, ½ mi. S Joplin, TD 4,705 ft., Caddo 4,376 ft., conglomerate pay 4,671 ft., flowed 7,500,000 cu. ft. gas a day, CP 800 psi., TP 1,275 psi., shut in.

Warren Oil Corp. 1 M. L. Smith, Joseph Bailey Sur., A-141, 6 mi. NW Jacksboro, TD 3,162 ft., Strawn pay 3,170 ft., pumped 81 bbl. of 42°-gravity oil a day, plus 24 bbl. water, GOR 395 cu. ft.

Montague County: A. V. Grant 2 Varnor Putnan, Jas. Ferguson Sur., A-261, 10 mi. N St. Jo, TD 2,135 ft., elev. 990 ft., pay 2,128 ft., pumped 21 bbl. of 40.5°-gravity oil a day.

Shackelford County: Anderson & Work 1 F. P. Armstrong, 13-A-AB&M, 6 mi. NE Leuders, TD 1,840 ft., elev. 1,551 ft., pay 1,824 ft., pumped 96.5 bbl. of 30°-gravity oil a day.

Starr Oil & Gas Co. 1 J. D. Windham "H," 80-12-T&P, 15 mi. SW Albany, TD 4,738 ft., elev. 1,861 ft., Ellenburger pay 4,728 ft., flowed 106 bbl. of 44°-gravity oil a day, 6/64-in. choke, GOR 215 cu. ft., TP 290 psi.

Throckmorton County: Dollie Adams 1 J. W. Tharp, Sec. 243, BBB&C Sur., 4 mi. NW Throckmorton, TD 4,545 ft., Caddo pay 4,532 ft., flowed 238 bbl. of 44°-gravity oil a day, 15/64-in. choke, GOR 670 cu. ft., CP 540 psi., TP 275 psi.

Bridwell Oil Co. 7 Zula Morrison, Sec. 16-2, TE&L Sur., 11 mi. SW Woodson, TD 782 ft., pay 5.0 ft., pumped 20 bbl. of 34°-gravity oil a day.

Young County: Mid-Continent Petroleum Corp. et al 1 Annie Leberman, Sec. 2-0, TE&L Sur., 7 mi. SW Jean, TD 4,814 ft., Mississippian 4,812 ft., pay 4,815 ft., flowed 249 bbl. of 44°-gravity oil a day, 14/64-in. choke, GOR 475 cu. ft., CP 350 psi., TP 275 psi.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

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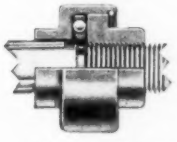

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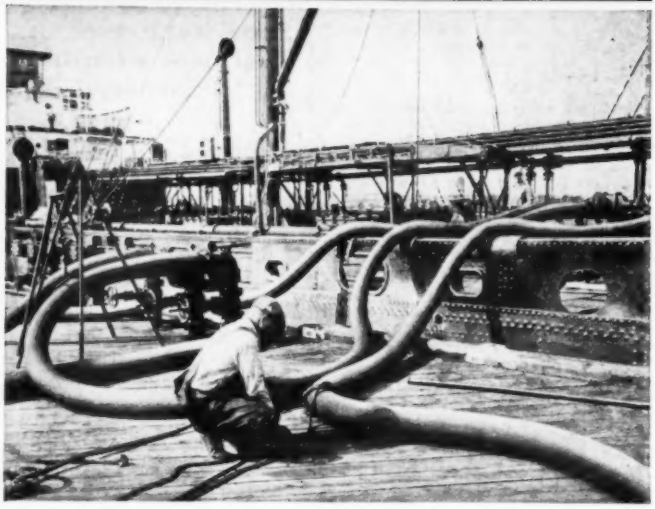

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1 Hedges, Sec. 2406, TE&L Sur., 5 mi. SE Megargel, dry, TD 3,012 ft.

C. D. Knight 1 O. Hemmi, Lot 16, Blk. 3, Clark & Plumb Subd., 1½ mi. SW Scotland, dry, TD 1,342 ft., no shows.

C. D. Knight 2 O. Hemmi, Lot 17, Blk. 3, 400 ft. E No. 1, dry, TD 1,342 ft.

C. D. Knight 1 V. E. Veitenheimer, Lot 60, Blk. 4, Clark & Plumb, 4½ mi. SW Windthorst, dry, TD 3,493 ft.

Neeld & Hood Drilling Co. 1 H. Veith, Blk. 3, Lot 59, Clark & Plumb, 2 mi. S Scotland, dry, TD 3,618 ft.

Oltex Drilling Co. 1 Mrs. Viola Hunt, Blk. 9, I. Holeman Sur., A-162, 6 mi. NW Olney, dry, TD 1,265 ft., sand with oil show 1,084-86, 1,251-53 ft.

Brown County: Con Oil Corp. 1 Oliver Steele, R. A. Slough Sur., A-1809, 2½ mi. NW Owens, dry, TD 1,147 ft., elev. 1,572 ft.

Callahan County: Pelican Petroleum Co. 1 W. H. Chambers, Sec. 60, BBB&C Sur., 1 mi. NW Clyde, dry, TD 2,302 ft., elev. 2,027 ft.

Clay County: Banner Drilling Co. 1 Fred Kafer, Blk. 95, Byers Bros. Subd., 1½ mi. SE Byers, dry, TD 1,908 ft.

Fain & McGaha 1 J. D. Burke, L. N. Sparks Sur., A-399, 2 mi. NE Deer Creek, dry, TD 4,808 ft.

Konrad Sztykgold 1 Pat Barry, Blk. 2, R. Gilleland Sur., A-162, 6 mi. S Windthorst, dry, TD 4,840 ft.

Coleman County: S. D. Johnson 1 J. W. Harris Estate, Sec. 63, H. Starnes Sur., 2 mi. S Santa Anna, dry, TD 2,455 ft., Caddo 1,978 ft., Marble Falls 2,435 ft.

Cooke County: D. H. Bolin 1 J. T. McCracken, W. C. Winters Sur., A-1086, 4 mi. NW Gainesville, dry, TD 2,971 ft., elev. 808 ft.

Sohio Petroleum Co. 1 Pringey-Scanlon, Blk. 81, Robert Finney Sur., A-389, 1 mi. SE Cosefield, dry, TD 6,500 ft.

Jack County: L. M. Lockhart 1 E. W. Lewis, W. Murray Sur., A-376, 10 mi. NE Jacksboro, dry, TD 6,584 ft., Ellenburger 6,484 ft.

Jones County: Perkins Bros. 1 R. S. Johnson, Austin & Williams Sur., 355, 3 mi. SE Hamlin, dry, TD 3,500 ft., elev. 1,725 ft., Dotham 2,436 ft., Camp Colorado 2,565 ft., Swastika sand 3,448 ft.

Montague County: R. J. Caraway and C. L. Norsworthy, Jr. 1 J. M. Small, Sec. 14, Limestone CSL, 3 mi. S Stoneberg, dry, TD 6,405 ft.

Stonewall County: Seaboard Oil Co. 1 W. L. Reese, 349-D-H&TC, 3 mi. from Peacock, TD 6,817 ft., elev. 1,859 ft., base Coleman Junction 3,124 ft., top Noodle Creek 3,516 ft., Ellenburger 6,676 ft.

Taylor County: Robinson-Puckett 1 Ethel T. Calvert, 125-64-H&TC, 6 mi. W Bradshaw, dry, TD 5,442 ft., upper Caps 4,365 ft., Caddo 5,060 ft., Ellenburger 5,219 ft.

Throckmorton County: Cities Service Oil Co. and Sinclair Oil & Gas Co. 1-41 S.M.S. Ranch, Sec. 41, BB&C Sur., A-44, 16 mi. W Throckmorton, dry, TD 5,817 ft., elev. 1,501 ft., Caddo 4,924 ft., Mississippian 5,310 ft., Ellenburger 5,610 ft.

Wichita County: Bridwell Oil Co. 3 Roller Estate, R. J. Scott Sur., A-256, 4 mi. S Iowa Park, dry, TD 4,153 ft.

Wayne Ferguson 1 W. P. Herron Estate, Sec. 8, W. H. Taylor Sur., A-764, 5 mi. E Electra, dry, TD 2,005 ft.

OHIO FIELDS

Knox County Well Gets Gas in Lower Clinton

COLUMBUS.—Willard Shrider 3 (6) Ray Earlywine, Section 8, Jackson Township, Knox County, drilled the upper Clinton at 2,992-3,020 ft. with a good oil showing at 3,013 ft., and the lower sand at 3,029-46 ft. with 250,000 cu. ft. of gas. After shooting, the well was putting 500,000 cu. ft. a day into the line through a separator. In the south center part of the township, the Preston Oil 1 Goldie Wolfe, Section 13,

gaged 480,000 cu. ft. of gas natural with only a small showing of oil. The well has been turned into the line for a test before shooting.

The E. O. White Drilling Co. has started a wildcat on Raymond Babst, Section 35, Beaver Township, Pike County, to go through the Trenton and into the St. Peter horizon. The probable total depth will be about 3,500 ft.

In South Roseville pool, the National Gas 1 J. E. Borbing, Section 9, Harrison Township, Perry County, made 132 bbl. of oil in 24 hours after shot.

New locations increased to 23 from 13 counties for the week. Ashland accounted for 3, while Knox, Tuscarawas, Muskingum, Noble, Morgan, and Perry had 2 each. Completions totaled 16 with Ashland field having 6 and Lancaster 4.

ILL.-IND.-KY.

Five New Pools Opened In Illinois and Indiana

ASHLAND OIL & REFINING CO. and associates have completed their 1 Appel, SE NE NE 28-6s-12w, opening another producing area in southeastern Posey County, Indiana. Placed on the pump after swabbing tests in which it made 83 bbl. of oil and 20 bbl. of water per day, the well produced at completion 67 bbl. of oil daily with a small amount of water. Production is from Cypress sand at 2,304-17 ft. (total depth 2,319 ft.). The new area, designated as the Ford South pool, is about 1½ miles south of the original Ford pool, and about 2 miles east of the Caborn area. It is the second pool opened in that area within the past month, it being about 2 miles north of a new Cypress sand discovery made by Superior Oil Co. at 1 Jordan, SE SW NW 4-7s-12w.

Another Cypress sand discovery well in Indiana has been completed by Aurora Gasoline Co. at 1 Nelson, SW SW NE 3-3s-10w, in central Gibson County. It pumped 42 bbl. of oil daily at completion with pay at 1,692-1,700 ft. Bottom of the hole is 1,749 ft. The discovery is about 2 miles east of the Princeton pool, nearest production.

In the same county, Ashland Oil & Refining Co. has extended production of the Owensville East pool to the southeast at its 2 Mason-Douglas Community, NE SE SE 7-3s-11e. Cleaning out and testing Cypress sand at 2,102-25 ft., the well swabbed at the rate of 14 bbl. per hour and appears an exceptionally good well for the area. Pay was shot with 60 quarts.

The Texas Co. has opened a new pool in western Clay County, Illinois, with the completion of its 1 C. T. Gabbert, NW SE NW 35-4n-5e. Producing from Benoist sand at 2,529-2,613 ft., the well pumped 5 bbl. of oil and about 13 bbl. of water daily at completion. Hole had been drilled to 2,891 ft. and plugged back to 2,655 ft. The discovery is about 2½ miles north of the North Kenner pool.

In the southwestern part of Edwards County, Illinois, Fred A. Noah & Sons appeared to be opening a new producing spot about 2 miles west of the South Ellery pool at their L. D. Moore, SW NE NW 30-2s-10e. The well has been put on the pump and makes about 55 bbl. of oil per day while testing McClosky lime at 3,328-33 ft. A total of 3,500 gal. of acid was used in opening the pay.

Henson Drilling Co.'s discovery well, 1 Richison, NE SE SE 29-1n-5e, 1½ miles southwest of Orchardville, Wayne County, Illinois, is being put on the pump following a swabbing test, in which it made 14 bbl. of oil in 12 hours. Pay zone is McClosky lime at 2,901-06 ft. Operators used 1,000 gal. of acid. Nearest production is in the Zenith South pool, 2½ miles to the north.

An extension of the New Harmony-Keensburg Consolidated pool, Wabash County, Illinois, C. E. Skiles 1 Edwin Schmidt, 990 ft. north and 1,515 ft. east of the southwest corner 18-2s-13w, has been completed on the pump for 100 bbl. of oil daily. Pay is the O'Hara lime at 2,812-22 ft.

Two additional good wells have been completed in the Caney Mound East pool in Union County, western Kentucky. Delta Drilling Co. 7 Walker heirs, 13-P-20, pumped and flowed 500 bbl. per day natural from O'Hara at 2,511-34 ft. (Total depth 2,640 ft.) The same operator's 8 Walker heirs, same section, pumped and flowed 300 bbl. per day, with hole open both in the O'Hara at 2,512-22 ft. and the McClosky at 2,578-90 ft. Both wells are on the south side of the pool, opened last year as one of the most prolific producing areas in the state.

ILLINOIS WILDCAT FAILURES

Bond County: C & M Production Co. 1 Krummel, SW SW SW 29-7n-3w, dry, TD 1,050 ft.

Christian County: J. T. McGinty 1 Sample, SE NE SW 26-15n-3w, dry, TD 1,893 ft.

Edgar County: Sun Oil Co. 1 Guymon, SW SW SW 20-13n-10w, dry, TD 2,140 ft.

W. A. Fullenkamp 1 Dougherty, SE SW NW 35-13n-12w, dry, TD 650 ft.

Lawrence County: Calvert Drilling Co. 1 Starkman, NE NW SW 7-2n-12w, dry, TD 1,860 ft.

C. H. Murdick 1 Cunningham, NE SW SE 15-2n-13w, dry, TD 2,734 ft.

Madison County: J. R. Bradshaw 1 Schuette, SW SE SW 9-6n-6w, dry, TD 560 ft.

Roy Updike 1 Randle, NW NE SW 21-6n-7w, dry, TD 573 ft.

E. A. Obering 1 Korsmeyer, SE SW SE 20-5n-5w, dry, TD 1,981 ft.

Marion County: L. E. Ostrom 1 Fouts, NW NW SE 36-1n-1e, dry, TD 2,482 ft.

INDIANA SUCCESSFUL WILDCATS

Gibson County: Aurora Gasoline Co. et al., 1 Nelson, SW SW NE 3-2s-10w, IP 42 bbl., Cypress 1,692-1,700 ft., TD 1,749 ft. (Opens new pool.)

Posey County: Ashland Oil & Refining Co. 1 Appel, SE NE NE 28-6s-12w, IP 67 bbl., Cypress 2,304-17 ft., TD 2,319 ft. (Discovery well Ford South pool.)

INDIANA WILDCAT FAILURES

Gibson County: C. Clements 1 Miller, SW NW SW 29-3s-8w, dry, TD 1,432 ft.

Posey County: Howard Atha 1 Schroeder, SE NW SW 15-6s-12w, dry, TD 2,688 ft.

V. R. Gallagher 1 Elliott, SE NW SW 36-7s-14w, dry, TD 3,000 ft.

Sullivan County: F. B. Cline 10.0. Marts, SE SE NW 32-9n-9w, dry, TD 1,450 ft.

Warrick County: R. T. McDermott 1 McNeely, SW SE NW 8-4s-6w, dry, TD 1,345 ft.

WESTERN KENTUCKY WILDCAT FAILURE

Hopkins County: C. F. Hancock et al., 1 Kirkwood, C 2-H-26, dry, TD 365 ft.

EASTERN KENTUCKY

ASHLAND.—In Big Sandy gas field, Kentucky West Virginia Gas Co. recently completed 5,883 Noah Newsom located on Indian Creek in Pike County. After shot with 4,450 lb. of gelatin, the well made 450,000 cu. ft. of gas daily from Devonian black shale at 2,775-3,444 ft., total depth. A show of oil and gas was also logged in the Big lime at 2,225 ft.

In Madison County, 11-P-61, Cooley Ellis et al are still shut down at 2,445 ft. at the 1 State Bank of Richmond. The test is thought to be bottomed in the upper portion of Knox dolomite with some water in the hole. It is rank wildcat in the Blue Grass area of central Kentucky.

In Knox County, 17-D-68, Triangle Oil & Gas Co. is drilling ahead at 4,432 ft. on 1 Stafford about 6 miles south of the county seat, Barboursville. The test is reported to be drilling the Knox dolomite section and, if so, will be only the second test in the entire county to reach this horizon.

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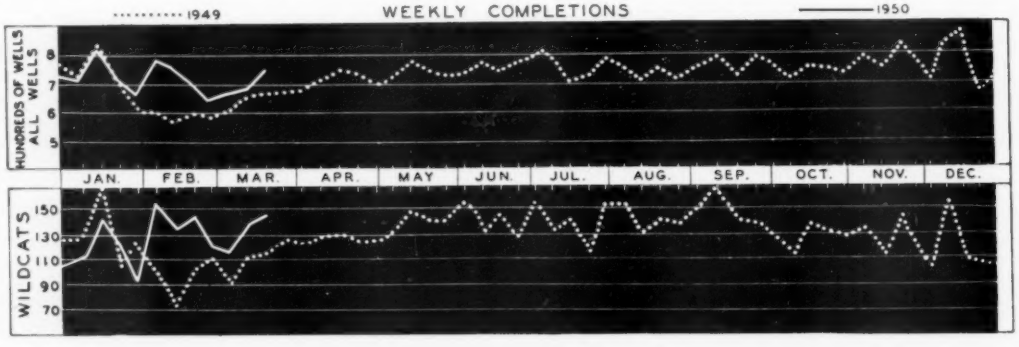
CURRENT STATISTICS

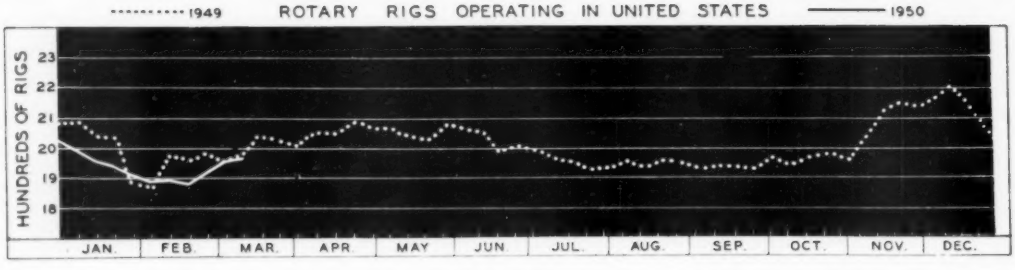
EXPLORATION

WEEKLY WELL COMPLETIONS . . . . . WEEK ENDED MARCH 18, 1950

	Total of all wells					Mar. 18		Wildcat completions and discoveries									
													Cumulative total, 1950				
	Comp.	Oil	Gas	Dry	Footage	1950	1949	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	9	4	0	*5	13,982	103	299	0	0	0	0	0	0	0	0	0	0
Pennsylvania	17	7	3	†7	28,977	243	509	0	0	0	0	0	0	0	0	0	0
West Virginia	16	5	8	3	35,317	126	105	0	0	0	1	1	0	0	2	4	6
Ohio	16	8	3	5	37,268	185	247	0	0	0	0	0	1	0	1	2	4
Indiana	21	8	1	12	44,852	210	265	2	0	0	5	7	8	0	1	25	34
Kentucky	20	10	5	5	35,466	166	165	0	0	0	1	1	3	0	0	12	15
Illinois	40	17	0	23	81,534	464	439	0	0	0	10	10	6	0	0	105	111
Michigan	12	4	0	8	34,464	140	153	0	0	0	4	4	8	0	1	60	69
Kansas	67	29	8	‡30	202,697	701	581	0	0	0	14	14	16	0	1	102	119
Nebraska	1	0	1	0	4,915	15	2	0	0	0	0	0	0	0	1	8	9
Oklahoma	92	54	1	§37	201,545	996	767	2	0	0	13	15	38	3	4	126	171
Texas	352	210	16	126	1,525,003	3,096	2,671	13	1	2	60	76	87	7	32	501	627
North Central (Dist. 7-B & 9)	116	49	3	64	342,307	932	825	8	0	1	22	31	33	1	9	168	211
West (Dist. 7-C & 8)	108	87	0	21	597,433	914	592	4	0	0	14	18	22	1	0	115	138
Panhandle (Dist. 10)	20	11	7	2	69,882	231	219	0	0	0	0	0	1	0	2	6	9
Eastern (Dist. 5, 6, & 6-P)	19	9	0	10	70,336	217	223	0	0	0	7	7	2	1	1	60	64
Gulf Coast (Dist. 2 & 3)	45	32	4	9	268,812	418	374	0	0	1	5	6	13	1	9	57	80
Southwest (Dist. 1 & 4)	44	22	2	20	176,143	384	438	1	1	0	12	14	16	3	11	95	125
Louisiana	33	22	1	10	218,250	479	424	0	1	0	4	5	13	5	3	38	59
Northern	12	8	1	3	43,049	247	220	0	0	0	2	2	3	0	0	19	22
Southern	21	14	0	7	175,201	232	204	0	1	0	2	3	10	5	3	19	37
Arkansas	3	1	0	2	8,342	69	49	0	0	0	0	0	1	0	0	19	20
Mississippi	5	0	0	5	41,250	59	72	0	0	0	3	3	2	1	0	20	23
Southeastern States	1	0	0	1	3,806	13	10	0	0	0	1	1	0	0	1	9	10
Montana	0	0	0	0	0	28	31	0	0	0	0	0	0	0	0	8	8
Wyoming	10	9	0	1	48,960	127	110	0	0	0	1	1	3	0	0	19	22
Colorado-Utah	0	0	0	0	0	15	20	0	0	0	0	0	0	0	0	12	12
New Mexico	11	5	4	2	29,781	‡38	115	0	0	0	1	1	6	0	0	13	19
California	27	23	0	4	128,329	380	537	1	0	0	4	5	6	0	2	72	80
Miscellaneous	1	0	0	1	3,808	2	13	0	0	0	1	1	0	0	0	2	2
Total United States	754	416	51	287	2,828,546	7,755	7,494	18	2	2	123	145	198	16	49	1,157	1,420
Total previous week	694	408	37	249	2,540,716			20	1	6	112	139	180	14	47	1,034	1,275
Total March 19, 1950	639	367	57	215	2,410,947			24	2	4	87	117	174	14	33	1,041	1,262

Service wells included: *5, †6, ‡1, §5.





DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 18 crude oil	B. of M. Mar. demand	Mar. 11 crude oil
Alabama	2,650	1,200	1,750
Arkansas	80,700	82,000	80,400
California	863,100	834,000	864,000
Colorado	59,900	67,000	57,900
Eastern	56,800	59,900	55,650
Florida	1,100	1,000	1,125
Illinois	177,800	180,000	181,000
Indiana	27,500	29,000	28,400
Kansas	259,700	285,000	251,150
Kentucky	25,700	25,000	25,800
Louisiana	506,750	544,000	506,850
North Louisiana	115,950		116,050
South Louisiana	390,800		390,800
Michigan	43,900	45,000	45,600
Mississippi	97,000	99,000	93,750
Montana	24,100	25,000	23,500
Nebraska	1,450	700	1,450
New Mexico	129,400	130,000	129,400
Oklahoma	418,650	413,000	418,050
Texas	1,838,450	2,100,000	1,838,450
Dist. 1 (Southwest)	25,850		25,850
Dist. 2 (Southwest)	113,450		113,450
Dist. 4 (Southwest)	181,625		181,625
Dist. 3 (Gulf Coast)	310,775		310,775
Dist. 5 (Eastern)	22,775		22,775
Dist. 6 (Eastern)	76,925		76,925
East Texas field	249,200		249,200
Dist. 7-C (West)	44,475		44,475
Dist. 8 (West)	531,800		‡531,800
Dist. 7-B (W. Central)	62,325		62,325
Dist. 9 (N. Central)	130,000		‡130,000
Dist. 10 (Panhandle)	89,250		89,250
Utah	2,900	1,200	2,300
Wyoming	159,000	128,000	155,209
Total United States	*4,776,550	5,050,000	4,761,725
Change from previous week, up	14,825		
Canada	75,160		

Total U. S. production January 1-March 18 †380,507,085 bbl.
Same period last year (crude plus cond.) 416,844,710 bbl.

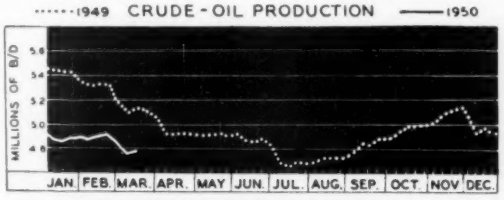
*Not incl. 97,315 bbl. condensate. †Incl. 7,050,645 bbl. condensate. ‡Revised.

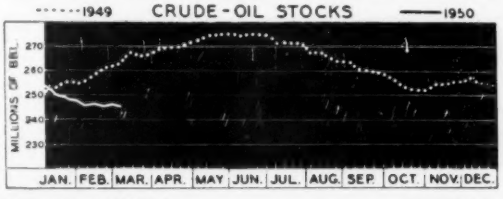
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

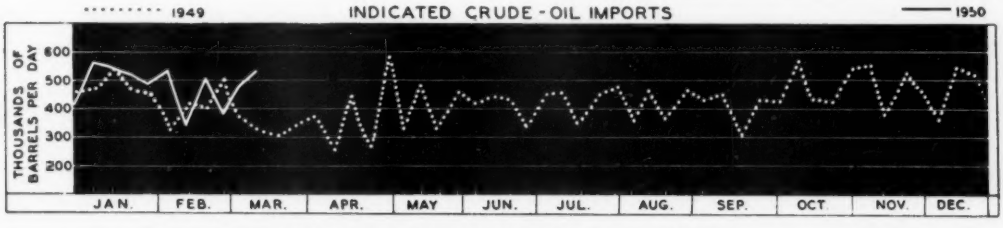
(Thousands of barrels)

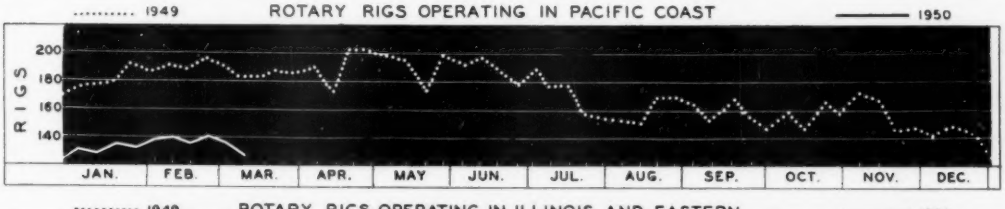
	Mar. 11, 1950	Mar. 4, 1950	Mar. 12, 1949
Pennsylvania Grade	2,691	2,776	2,835
Other Appalachian	1,588	1,705	1,552
Illinois, Indiana, Michigan	10,894	10,838	14,022
Arkansas	3,192	3,103	3,212
Louisiana	16,191	15,691	13,101
North	3,912	3,673	3,268
Gulf	12,279	12,018	9,833
Mississippi	2,609	2,420	2,985
New Mexico	6,945	7,443	7,223
Oklahoma and Kansas	35,197	34,839	38,112
Texas	107,383	109,170	126,624
East Texas	14,727	14,849	16,696
West Texas	37,117	38,137	52,198
Texas Gulf	29,400	29,399	29,215
Other Texas	26,139	26,785	28,515
Rocky Mountain	13,621	13,604	12,633
California	37,966	37,814	33,487
Foreign	7,425	7,051	8,385
Total	245,702	246,454	264,171

*Bureau of Mines.







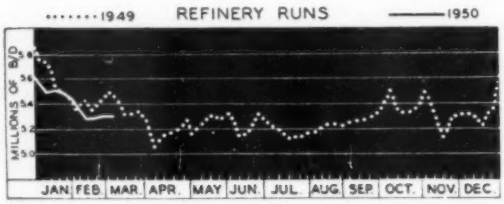


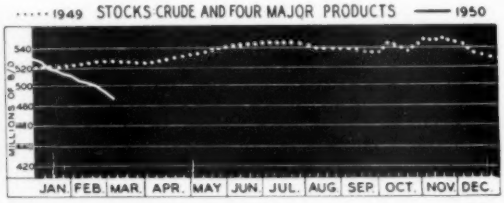
A.P.I. REFINERY REPORT, MARCH 11

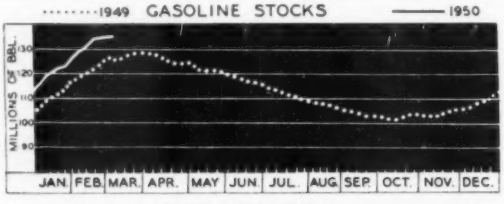
(Thousands of barrels)

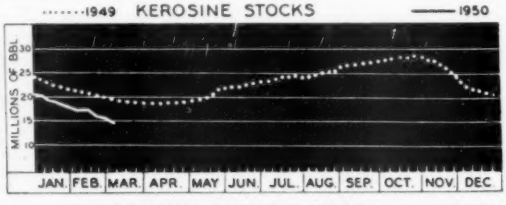
District—	Daily avg. crude runs	Daily average production				Stocks at refineries, bulk terminals, in transit and in pipe lines				Bureau of Mines, March 1949				
		Gasoline*	Kerosine	Distillate	Residual	Gasoline†	Kerosine	Distillate	Residual	Daily avg. crude runs	Daily average production Gasoline*	Kerosine	Distillate	Residual
East Coast	823	328.7	34.0	187.9	211.7	27,624	6,122	13,281	8,567	768	305.4	27.8	164.6	210.3
Appalachian:														
District 1	87	45.7	8.4	14.9	9.0	2,722	278	444	207	83	40.9	5.0	10.1	11.6
District 2	61	26.1	5.9	12.4	13.1	1,077	85	132	89	65	32.9	3.3	6.0	15.1
Ind., Ill., Ky.	998	504.9	60.1	153.6	183.9	27,821	2,343	5,630	2,145	886	469.0	57.9	125.1	155.6
Okla., Kans., Mo.	436	252.3	27.0	89.0	58.1	14,478	521	2,780	829	422	218.1	22.6	85.7	73.2
Inland Texas	202	144.1	10.0	25.9	44.3	4,255	233	710	547	220	137.1	13.7	20.5	53.3
Texas Gulf Coast	1,187	561.3	102.6	202.8	223.9	20,119	2,039	8,837	4,551	1,291	601.9	84.1	233.6	236.3
La. Gulf Coast	400	194.9	57.0	77.4	43.3	7,438	1,417	2,863	2,227	433	195.9	47.5	91.3	57.5
N. La. and Ark.	81	25.6	7.8	11.9	15.6	3,643	221	478	243	75	27.8	7.9	11.2	16.9
Rocky Mountain:														
New Mexico	10	5.6	.3	1.3	2.3	94	25	75	35	11	6.4	.4	1.5	3.0
Other Rocky Mtn.	186	89.1	7.3	31.1	37.3	5,225	231	1,480	503	165	71.3	5.4	30.5	38.8
California	843	337.1	26.6	84.7	330.4	20,788	892	9,865	24,601	933	363.0	13.9	152.6	386.3
March 11, 1950	5,314	2,515.4	347.0	892.9	1,172.9	135,284	14,407	46,575	44,544	5,352	2,469.7	289.5	932.7	1,257.9
March 4, 1950	5,316	2,529.6	312.0	1,006.9	1,162.8	134,208	15,466	51,670	46,086					
March 12, 1949	5,452	2,466.7	299.0	1,046.4	1,160.7	126,188	18,517	51,804	58,707					

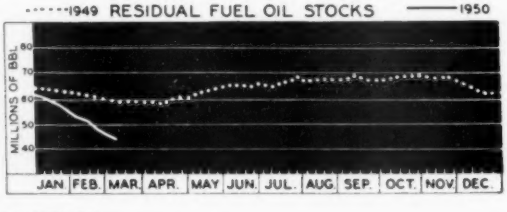
*At refineries including natural blended. †Finished and unfinished.

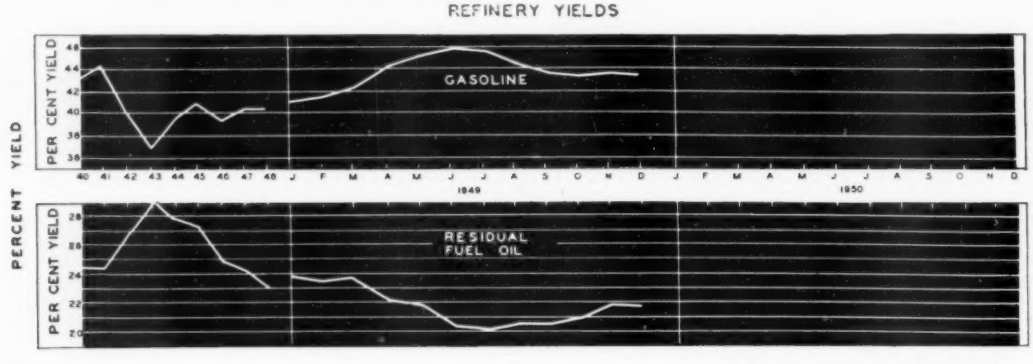












CRUDE PRICES
GRAVITY SCHEDULE

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.53			
19-19.9	1.63			
20-20.9	1.73	$2.25		$2.12
21-21.9	1.82	2.27		2.14
22-22.9	1.92	2.29		2.16
23-23.9	2.02	2.31		2.18
24-24.9	2.12	2.33	$2.56	2.20
25-25.9	2.22	2.35	2.58	2.22
26-26.9	2.31	2.37	2.60	2.24
27-27.9	2.37	2.39	2.62	2.26
28-28.9	2.42	2.41	2.64	2.28
29-29.9	2.48	2.43	2.66	2.30
30-30.9	2.54	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.64	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6, 1947. Above changes do not include recent reductions of a few buyers applying principally to low-gravity grades.

FLAT CRUDE PRICES

Representative posted schedules per barrel

East Texas†	$2.65
Kettleman Hills, California*	2.77
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	3.54
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°, †35° and above.

RECENT reductions in gasoline tank-wagon prices have tended to eliminate the difference between established postings and cut prices, many of which were in the form of discounts. These reductions in postings ranged from ½ cent to 1½ cents a gallon but in many cases did not represent actual reductions in selling prices. Price cutting at service station and tank-wagon levels, which started earlier in the season, has reduced the margin between refinery and tank-wagon prices. Since Group 3 gasoline prices started to soften in the late months of 1948, the "low" for this market has dropped more than 1 cent a gallon. In general, Midwest tank-wagon prices did not follow this downward trend until after the end of the 1949 gasoline season.

While there is little evidence of softening in the Group 3 market resulting from tank-wagon cuts, the reductions may have some effect on the over-all market. Companies with both refining and marketing facilities were realizing more on gasoline sales than was indicated by spot-market quotations, since a large part of total gasoline production was marketed at tank-wagon or service-station levels. Price reductions at these levels may extend to integrated companies the squeeze that has been felt by smaller refineries for more than a year.

Heavy reductions in Gulf-East Coast distillate stocks for the second week tended to check rumors of further price reductions in the New York Harbor area. In the 2-week period ended March 11, distillate inventories in these districts were reduced almost 7,000,000 bbl. out of a total drop of 9,500,000 for the country as a whole. Harbor barge prices remain at 7.4-7.6 cents a gallon.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of March 20, 1950. Figures are f.o.b. plant for tank-car shipments in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Tex. Gulf Coast
Regular gasoline, 74-76 octane	9⅜-9¾	10.375-10.6	9-9¾
Premium gasoline, 78-80 octane	10⅜-10¾	11.5-11.6	9¾-10¾
42-44 w.w. kerosine	8½-8¾	8.8	8-8½
No. 2 straw fuel oil	7⅝-7⅞	7.4-7.6	6½-7
No. 6 residual	$1.50-1.60	$1.90	$1.50-1.60

NATURAL GASOLINE

	Group 3	North Texas	N. La
Grade 26-70	4	3½	3¾
Grade 18-55	4.8	4.3	4.55

LUBRICATING OILS

South Texas

200 vis., No. 2-3 neutral	10.5
750 vis., No. 3-4 neutral	12.75
2,000 No. 5-6 neutral	14-14.5

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp	17
200 vis., No. 3 neutral, 0-10 pp.	11.5-12.5

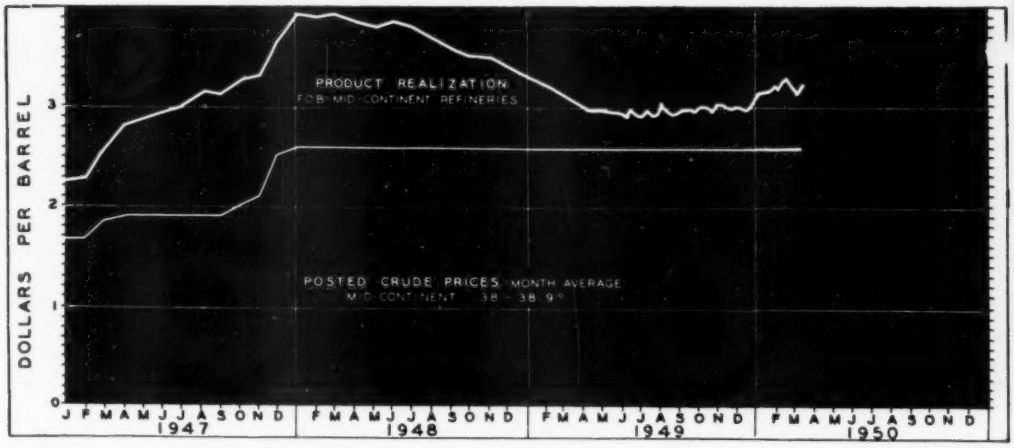
Western Pennsylvania

145-155 vis., 10 p.t. bright stock	19.5-20.5
180 vis., 0 p.t. neutral	20.5-21.5

WAX

Mid-Continent

132-134 A.M.P.	4.25


PRODUCT REALIZATION
F.O.B. MID-CONTINENT REFINERIES
POSTED CRUDE PRICES MONTH AVERAGE
MID-CONTINENT 38 - 38.9°
DOLLARS PER BARREL
0
1
2
3
J F M A M J J A S O N D
1947
J F M A M J J A S O N D
1948
J F M A M J J A S O N D
1949
J F M A M J J A S O N D
1950

In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil

EQUIPMENT MEN . . . in the News

Morgan to Devote Full Time to Pipe-Coating Firm

T. A. Morgan, after serving as general superintendent of Houston Industrial Gas Corp. and associated companies for 4 years, has resigned to devote full time, in the capacity of president, to the Gulf Coast Pipe Coating Corp. in Houston.

Morgan began his career as field engineer with Houston-Gulf Gas Co., now United Gas Corp., in 1926. He was associated with Lone Star Gas Co. in various engineering capacities from 1929 to 1939 and at the time assumed the position of chief engineer with Houston Natural Gas Corp. In 1946, he became general superintendent of Houston Industrial Gas Corp.

Wisconsin Motor Names Norton as Vice President

PHIL NORTON

Appointment of Phil Norton, general sales manager of Wisconsin Motor Corp., Milwaukee, as a vice president of the company has been announced by Harold A. Todd, president, following the annual stockholders' and directors' meetings. Norton has been with the company in a sales capacity for more than 20 years, occupying executive position of general sales manager for the past 10 years. Recently another honor was conferred upon Norton through his election to the post of president of the Internal Combustion Engine Institute.

Pettibone Mulliken Buys Johnston & Jennings Co.

Pettibone Mulliken Corp., a 70-year-old Chicago concern, has purchased Johnston & Jennings Co. of Cleveland, including its Oceco division; vent valves, flame arrestors, gages, swing lines, and other tank equipment. The entire finished inventory of Oceco products, including all work in process, and records have been moved to the Pettibone Mulliken 30-acre Chicago plant.

George Fox, sales manager, and certain key engineering and production personnel, have been moved to Chicago. Sales representation continues practically unchanged. The company will be known as Johnston & Jennings Co., division of Pettibone Mulliken Corp.

Enterprise Names Rasey As Engine Division Sales Head

Appointment of Gerald C. Rasey as sales manager of the engine division, Enterprise Engine & Foundry Co., has been announced by James S. Watson, general sales manager. Rasey started as an apprentice engineer in 1918 while attending college, and in the intervening years has been continuously identified with the diesel engine field in both engineering and sales.

During World War II, Rasey served with Joshua Hendy Iron Works as sales manager of the diesel department. Hendy diesels are now the Enterprise "H" series, widely used in both stationary and marine installations. Rasey is located in the San Francisco headquarters.

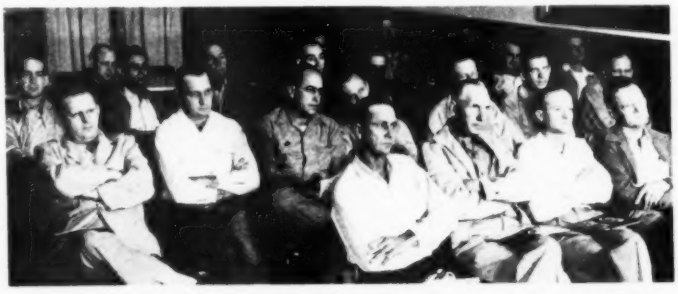
H. G. Smith Joins Ohio Injector as Vice President

H. G. SMITH

Harry G. Smith has been appointed vice president and director of sales for Ohio Injector Co., Wadsworth, Ohio. The appointment was announced by Wayne Young, president of the valve manufacturing firm.

Smith comes to O.I.C. from A. O. Smith Corp., Los Angeles, where he was manager in full charge of administration, sales, manufacturing, and engineering of the meter division. He has been associated with the oil industry for 13 years. He began his career in the petroleum field as a research engineer for Smith Meter Co., a former subsidiary of A. O. Smith Corp., progressing through engineering and sales departments to vice president and general manager. When Smith Meter was absorbed by the parent company he continued as manager of the new division.

Cameron Conducts Educational Series on New Valve



J. S. Abercrombie superintendents and foreman attending the demonstration of the Cameron LP valve are: front row, Mitchell Collier, Rod Martin, Weldon Bailey, and Pete Fisher; second row, Bill Hagner, Bill Long, Homer Adams, Iver Boles, Ted Lytle, Jesse Hargis, and Fred Railsback; third row, Ycakum Lynn, Roy Ward, Fred Doolen, Jimmie Collins, Bill Hudson, Bob Burkett, Wayne Eversole, and Taylor Kent, Jr.; back row, Harry Elliott, Slick Wallas, Slim Reeves, and Charley Burney.

The first of a series of on-the-spot educational demonstrations of the new Cameron nonlubricated lift plug valve was conducted recently for the foremen and superintendents of the J. S. Abercrombie Co. gasoline plant at Sweeny, Tex.

According to officials of Cameron Iron Works, the "LP valve may be completely overhauled without removing it from the line. It employs a separate and removable seat which facilitates field repair, permits any desired trim, and is caused to seal tightly around the plug when exposed to line pressure."

It is for the purpose of acquainting the industry with these features of the valve that the manufacturer is conducting demonstrations.

This new warehouse of Vinson Supply Co. is 70 ft. wide by 150 ft. long. The building is equipped with a large overhead crane to move pipe directly from warehouse to railroad cars.

Vinson Supply Opens new Warehouse at Tulsa

Vinson Supply Co. has just completed a new $75,000 warehouse in Tulsa in order to maintain a complete stock of pipe, valves, fittings, and controls, according to an announcement by J. M. McReynolds, executive vice president of the firm.

Vinson is distributor for Fisher Governor control equipment, National Tube seamless pipe, Chase Brass & Copper Co., Nordstrom Valve Co., and Ladish Co.

In addition to the Tulsa plant, Vinson Supply maintains offices and warehouses in Dallas and Odessa, Tex. C. B. Grant is secretary-treasurer, G. B. Lane is manager of the Dallas office, and B. E. Keeling is in charge of the Odessa office. J. H. Heinzerling is manager of the Vinson Fisher control division. Vinson Supply is sole distributor in Oklahoma, parts of Texas, Arkansas, and New Mexico for Fisher control equipment.

Team Work Accounts For Fast Exchanger Delivery

American private enterprise and its cooperative spirit combined to make record delivery on a rush order for a heat exchanger this month, when Western Supply Co. of Tulsa was able to complete an A.S.I. Type 347 stainless-steel heat exchanger in just 3 days for Phillips Chemical Co.'s Etter, Tex., plant.

Receiving the order late Friday afternoon, March 11, Western proceeded to order the scarce grade of steel from Metal Goods Corp. in St. Louis. By 11 p.m. that night the rough blueprints were ready for Phillips' approval the following morning.

J. E. Hughes, manager of heat-exchanger sales for Western took the prints to Bartlesville Saturday for approval. Meanwhile, Metal Goods in St. Louis had shipped the steel via Frisco Saturday morning, and the material was delivered to Western's shops in Tulsa early Sunday morning.

Beginning immediately upon receipt of the steel, Western was able to finish machining all parts by 4 p.m. Sunday. Early Monday morning, the unit went into the welding shop, thence into assembly, and by noon of Monday, March 13, the completed unit had been hydrostatically and pneumatically tested, and was ready for shipment to Phillips' plant at Etter.

Oilwell Announces Two New Store Managers

C. H. Maynard, Oil Well Supply Co.'s eastern division manager, has announced the appointment of Paul E. Hunter as manager of Oilwell's Clarksburg, W. Va., store, and the promotion of James A. Durham, formerly storeman in the Charleston, W. Va., store, to store manager, succeeding C. E. Lewis, who has been transferred to Odessa, Tex., as field representative.

Hunter has been connected with Oilwell for 17 years and has been manager of the Franklin, Pa., store since 1942. Durham was connected with Oilwell's Parkersburg, W. Va., store before moving to Charleston. Lewis became store manager at Charleston in 1946. Prior to that time he was field salesman at Clarksburg.

Joys Made Assistant to Vice President of A. O. Smith

A. O. Smith Corp. has announced that Carl Joys, Jr., who was connected with the company for many years as a sales executive, has rejoined the firm as an assistant to the president.

Joys has been associated with the petroleum and oil-refining industries, and his new duties with A. O. Smith will center primarily in this field. He originally joined A. O. Smith in 1924. He left the company in 1939 to establish his own sales company, and later became sales executive of the plate and welding division of General American Transportation Corp.

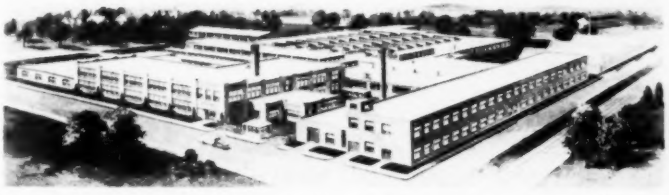
Quaker Rubber Opens New Pittsburgh Branch

Quaker Rubber Corp., Philadelphia, now a division of H. K. Porter Co., Inc., of Pittsburgh, has opened a new stock-carrying branch at Pittsburgh. The new branch is under the direction of H. M. Sossaman, who was assistant general sales manager for Quaker before his appointment to this new position.

Sossaman is in his twenty-third year with Quaker, beginning as a salesman in the Florida territory. In 1943 he was appointed assistant general sales manager.

Quaker Rubber Corp. is manufacturer of industrial rubber belting, hose, packing, and special molded rubber products. The firm is one of several divisions of H. K. Porter. Other divisions include Hinderliter Tool, Quimby Pump, American Fort

Crosby Steam Gage and Ashton Valve Occupy New Plant



Crosby Steam Gage & Valve Co. and Ashton Valve Co., under common ownership and management have moved into this new plant at Wrentham, Mass. This plant, according to William P. Husband, president of the Crosby concern, combines for the first time the manufacturing operations of the two companies. The plant contains over 100,000 sq. ft. of floor space and is newly equipped with modern machinery. It is connected with the Boston sales office by direct wire. Additional sales offices are located in New York, Chicago, Dallas, and Los Angeles.

Pitt Spring, J. P. Devine, Brake Equipment & Supply, and Jarecki Manufacturing Co.

Valve Manufacturers Ass'n. Elects Holton President

The Valve Manufacturers Association, a national organization, held its annual meeting in February in New York City, at which time W. B. Holton, Jr., president of Walworth Co., was reelected president of the association.

Ernest Cochran, vice president of Chapman Valve Mauufacturing Co., and Charles W. Burrage, secretary of Lunkenheimer Co., were reelected vice presidents. Wayne Young, president of Ohio Injector Co., was elected a vice president. George A. Cooper, of New Rochelle, N. Y., was reelected secretary-treasurer.

A spokesman for the association states that the industry expects a good volume of business in the early part of 1950, but ventures no prediction for the last half of the year. Backlogs of orders vary by class of product, but are generally considered as normal for present construction programs, which directly affect the industry.

Alloy Steel Appoints New Distributors and An Agent

Alloy Steel Products Co., of Linden, N. J., manufacturers of Aloyco valves and fittings of stainless steel and other corrosion-resistant alloys, has announced the appointment of the following concerns as distributors: Republic Supply Co. of California at Emeryville and Los Angeles, and Railway & Power Engineering Corp., Ltd., at Toronto, Ont.

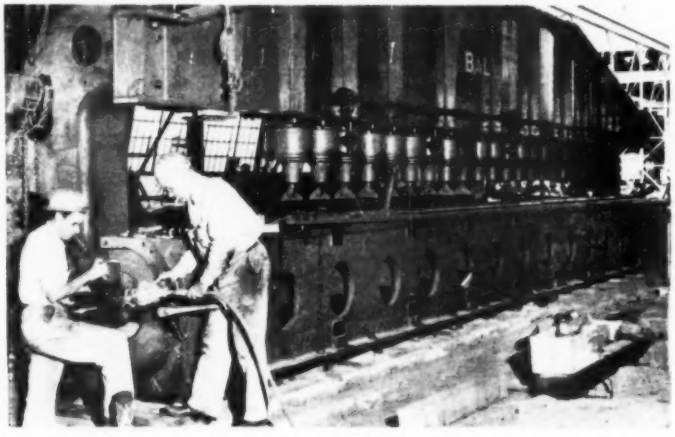
Aloyco also has announced the appointment as manufacturers' agent in Utah, southern Idaho, Wyoming, and Colorado, of Wetzel Equipment Agency at Salt Lake City.

C. G. Wood Elected to Board of Karyall Body

Clarence G. Wood, who recently resigned as director of sales for American Coach & Body Co., has acquired a stock interest in Karyall Body, Inc., Cleveland, and has been elected a member of the board of directors and vice president of the firm. He will direct all sales activities.

Karyall Body, formerly W. V. G. Sheet Metal Products, Inc., is manufacturer of conveyor baskets, tote boxes, heat-treating containers, and utility bodies, side compartments, revolving ladders, and hydraulic tower lifts for vehicles.

Consolidated Western Completes Texas Steel Plant



First piece of equipment to be installed at Consolidated Western Steel's large-diameter pipe mill at Orange, Tex., is this edge planer. The machine's powerful cutting assembly, not yet installed when the picture was taken, will plane edges of steel plate for welding into pipe.

The new pipe mill and steel-plate fabricating shop at the Orange, Tex., plant of Consolidated Western Steel Corp. are scheduled to go into production this month, according to H. C. Cranfill, vice president in charge of administration of the firm. Consolidated Western is a subsidiary of United States Steel Corp.

The plant is being installed on the site of the Orange wartime shipyard which was purchased from the Government late in 1949. Part of the plate mill is already in operation and a considerable amount of fabricated plate is being turned out. The shop will be devoted to light and heavy plate fabrication of mild steel, stainless steel, and nickel-clad vessels. Its output principally will be for the petroleum refinery and chemical industries of the Gulf Coast.

The pipe mill will produce 24-in.-diameter and larger electric welded and expanded steel pipe. First production of the mill will be 31-ft. lengths of 30-in. pipe. The mill is geared for 50 miles of pipe a month.

Acidizing Station Opened By Western Co. at Borger

An oil and gas-well acidizing station for service to the Panhandle area has been opened by Western Co. in Borger, Tex., it has been announced by Walter Beadle, manager of Western's acidizing department.

C. E. INMAN

O. M. BAKER

C. W. MATTHEWS

Men who will be in charge of operations in that area will be C. E. Inman, Panhandle district manager; Clifford W. Matthews, district geologist; and Orville M. Baker, station manager. Temporary offices are located in the Keith Building in Borger.

Western has transferred some of its most experienced personnel to the new station and will introduce into the area its engineered acidizing and specially designed equipment for treating oil and gas wells. Other treating and perforating stations of Western are located at Odessa, Snyder, Levelland, Seagraves, Tex., and Eunice, N. M.

A. G. Hendrickson Named Assistant Sales Manager

Announcement is made by Harnischfeger Corp., Milwaukee, of the appointment of A. G. Hendrickson as assistant sales manager of the P&H Welding Division.

Hendrickson has had many years of experience with P&H, serving for 5 years as welding engineer in the Milwaukee and the Minneapolis territories. He will be assistant to Melvin O. Monsler, who was recently promoted from assistant to sales manager. P&H products in the welding field include a.c. and d.c. arc welders, welding electrodes, welding positioners, and welding production control systems.

Duckworth Appointed Vice President by Thomas Bryan

S. B. DUCKWORTH

Appointment of S. B. Duckworth as vice president in charge of western division operations was announced by Thomas S. Byran, president of Thomas Bryan & Associates, Inc., constructors and engineers, Houston. Duckworth will be in charge of the corporation's project in West Texas, New Mexico, Arizona, California, Nevada, Oregon, and Washington.

Richard L. Young, construction superintendent of the Los Alamos, New Mexico, power-plant project under construction by the firm, was named western division construction superintendent under Duckworth. Frank Graziani, purchasing agent, will be transferred from Houston to Los Alamos as office manager on the power-plant project.

Duckworth, vice president in charge of engineering for the corporation during the last 2 years, is an engineer of long experience in the construction field. A graduate of Missouri State College, Duckworth served from 1927 to 1940 as construction superintendent, Great Lakes Construction Co. As construction superintendent for John Griffith & Son Construction Co., from 1940 to 1943, he supervised construction of Navy bases and housing projects. He joined Thomas Bryan & Associates in 1945.

Frank Gernand Appointed Onan Sales Representative

F. GERNAND

Hiram Hascall, sales manager of D. W. Onan & Sons., Inc., manufacturers of electric generating plants, has appointed Frank Gernand of Portland, Ore., as direct factory sales representative covering the entire West Coast and the Territory of Alaska.

Well known throughout the western states and thoroughly familiar with Onan products, Gernand will maintain headquarters at Portland, but will spend the majority of his time working directly with Onan dealers and distributors in the field.

Wells Promoted by PB

Jack Magoffin, sales manager of Patterson-Ballagh, division of Byron Jackson Co., has announced the promotion of A. O. Wells. Wells will be the new district manager for Patterson-Ballagh in West Texas, with headquarters in Odessa. As assistants to Wells for the West Texas area will be Bob Shira, Gene Mitchell, and Rhoal Lyles.

Larkin Packer Opens New Warehouse at Kilgore

Larkin Packer Co., St. Louis, has opened a new warehouse in Kilgore, Tex., it was announced recently by T. E. Alexander, sales manager.

The opening of this warehouse will in no way affect Larkin's other eight distribution points. A complete stock will be carried and the warehouse will materially increase the service Larkin can give to its East Texas customers.

Baker and Taylor Advanced By Lane-Wells Co.

J. S. BAKER W. J. TAYLOR

The Pacific Coast division of Lane-Wells Co. has announced the appointment of J. Shannon Baker to the position of division operating engineer. W. J. (Doug) Taylor succeeds Baker as district superintendent in Bakersfield, Calif. Taylor was formerly assistant superintendent in this district.

Baker has been with Lane-Wells since 1938. He worked in the operating department as electrolog operator until he became the Los Angeles district sales engineer in 1945. The following year he was appointed Bakersfield district superintendent. Prior to joining Lane-Wells he was employed by the Rieber Geophysical Laboratory.

Taylor started with the company as perforating rigman in 1941. He advanced to perforating operator and then to electrolog operator. In 1946 he advanced to district sales engineer and assistant district superintendent, both in Bakersfield. He had previously worked for R. C. Water's Geophysical Co.

Schlumberger Shifts Davis

R. C. Davis, from Cody, Wyo., has been transferred to Hobbs, N. M., as manager for that district of Schlumberger Well Surveying Corp. He replaces G. J. Decker, who is moving to Edmonton, Aalta., on a special assignment.

Binger Named to New Post With Minneapolis-Honeywell

J. H. BINGER

Election of James H. Binger as vice president and general manager of the Belfield Valve division of Minneapolis-Honeywell Regulator Co. has been announced by Harold W. Sweatt, president. L. M. Morley, vice president and general sales manager of the company's industrial activities, has announced the appointment of K. R. Knoblauch as manager of sales of valve products for the industrial division.

Binger will have charge of engineering and manufacturing in the valve division and will coordinate valve sales through other divisions of the company. He has been with Honeywell since 1943, having been promoted from assistant vice president to his new office.

Knoblaucn joined Brown Instruments division of the company in 1924. In 1933 he was made assistant sales manager of the industrial division. Four years later he was placed in charge of market extension and sales promotion.

Oil Companies Exhibit at Cost-Cutting Exposition

Rapid growth in importance of cutting oils, coolants, and lubricants in industry is indicated by the fact that 10 important oil companies have taken space in the Industrial Cost-Cutting Exposition to be held in Philadelphia, April 10-14.

Among the companies are: Alpha Corp.; F. E. Anderson Oil Co.; Cities Service Oil Co.; Gulf Oil Corp.; Shell Oil Co.; Socony-Vacuum Oil Co., Inc.; Sun Oil Co.; D. A. Stuart Oil Co.; The Texas Co.; Tide Water Associated Oil Co.

Increased machine speeds, more rapid metal cutting, and the need to hold closer tolerances for maximum interchangeability of parts in assembly are given as principal reasons for the importance currently attached to selection of oils to be used.

The exposition, sponsored by the American Society of Tool Engineers, is expected to attract major industrial executives whose direct concern it is to reduce manufacturing costs. Over 300 exhibitors are participating.

Kent Made Store Manager

Continental Supply Co. has appointed O. A. Kent manager of its El Dorado, Kans., store. He was formerly a field salesman at that location.

(Continued on page 398)

CLASSIFIED ADVERTISING

Your MARKET PLACE FOR THE OIL AND GAS INDUSTRY...

DISPLAY CLASSIFIED
$12.00 a column inch one issue . . .
10% Discount three or more issues.

UNDISPLAYED CLASSIFIED 12c a word one issue. 10% Discount three or more issues. $3.00 minimum charge. Blind Box in our care counts nine words. Payable in Advance.

EQUIPMENT FOR SALE

FOR SALE: 1—36-L Bucyrus Rig, 1948 model, complete with all tools. Phone 2032, Henderson, Kentucky.

WAR SURPLUS MACHINERY
Gaso, Byron Jackson, Aurora, Wayne, Lombard, & Hale Fire Pumps with Engines, 1½ to 25 KW Generator Sets of Light Plants, Engines, Suction Hose, Fire Hose, Victaulic Couplings & Etc. Write for listing. H. A. McCarthy, 310 Thompson Bldg., Phone 5-3296, Tulsa, Oklahoma.

7¼ x 12 GARDNER-DENVER Mud Hog Pump. Stored at Wichita Falls. D. F. MacKinnon, 3200 Main Street, Dallas, Texas. Phone C-6415.

BESSEMER TYPE 10-80 HP Direct Driven Compressor. Choice of high or low pressure cylinders. Patton and Swab, Inc., Citizens Bank Bldg., Phone 3-3181, Tulsa.

ONE Skid mounted 5 x 10 Gardner Denver Pump with 525 Buda Engine used to drill five shallow holes—$3000.00. Riverside-6811, Dallas, Texas.

FOR SALE

GRINDING MACHINES FOR RECLAIMING USED STAINLESS STEEL BALL VALVE SEATS FROM ¾" TO 2¼" BALL SIZES. SAVE 75%. WRITE FOR DETAILS.

THE BALL VALVE SEAT GRINDER CO.
102 Jamesville Rd.
DeWitt, New York
(Suburb of Syracuse)

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE: Two steel mud tanks, 5 feet by 8 feet; 30 feet long, made of ¼" steel, sloping bottom. Never been used. $3200. Located Makin Drilling Company's yard, Hobbs, New Mexico.

TUBING: Hard drawn copper, finned, mfg'd by Rome-Turney, new, ⅝" OD x .049" wall, lengths 6', 7' and 8'—approximately 150,000' Total. Julius M. Fogelman, Reading, Pa.

TWO CARDWELL DOUBLE-DRUM SPUDDERS: All tools, light plants, doghouses, portable masts. Also 96' Portable Drill Mast with 4½' sub-structure. Wallace, Box 4563, Oklahoma City, Okla. Phone 62-2415.

FOR SALE: ½ yard K-12 Insley with complete trench hoe attachment. Diesel engine, extra long and extra wide (swamp) tracks, also 35 ft. dragline boom with fairleads, in absolutely first-class condition. $7,000.00. C. W. Sternberg, Box 8188, Houston, Texas. Phones Justin 1984, South Houston 7651.

Several Army Surplus 4½" x 6" Gaso Duplex 1860 Pumps—two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price.

H. H. COFFIELD
ATTN: W. H. Orr
Phones: 132—Rockdale, Texas
A-86084—Houston, Texas

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NEW—Less than 50% replacement cost.
EXPLOSION PROOF
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120,000 ft. 2" OD
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EQUIPMENT FOR SALE

SEISMOGRAPH EQUIPMENT FOR SALE: Two 2-Ton Chevrolet Coleman 4-Wheel Drive water trucks, 500 gallon tank completely winterized, vacuum fill, Tulsa winch, etc. Excellent condition, low mileage. Original Cost $6600.00—Sale Price $4000.00.

One ½-Ton Chevrolet crew and field service unit. Bed enclosed with steel, cab with heater, 65 gallon gas tank with gear pump. 7.50 x 15 tires. Low mileage. Original Cost $2800.00—Sale Price $1800.00. Riverside-6811, Dallas, Texas.

FOR SALE: Used Cooper Skid Model E well servicing unit, mounted on 6X6 GMC with new motor and good rubber. With or without 8 X 10 X 60 ft. mast and tools. Unit located at Seminole, Okla., Box D-388. The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Approximately 10,000 feet of 6" OD "Invasion" Steel Pipe. Wt. about 9#, 6⅝" OD Plain Ends, 20' lengths. New condition. Also, approximately 15,000 feet of 6⅝" OD Plain End Standard Black Steel Pipe, No. 2 Grade. Price, 65c per ft., FOB Monroe, La. M. KAPLAN & SON, Box 1883, Phone 942, Monroe, Louisiana.

FOR SALE: One used Patterson rebuilt 27" round rail 72 chamber filter press with 2½" feed end opening, good condition. American Liberty Oil Company, Box 1011, Mt. Pleasant, Texas.

FOR SALE: In West Texas, Model 61 Wichita Spudder, complete with 150 H.P., LeRoi Drilling Engine, all tools, dog house, light plant, and Shear Pole Mast. Rig is mounted on 12" I Beam Skids. Box D-228, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: One Gardner-Denver Horizontal Drilling Engine 12X12 DEA equipped with Roller Drive Chain for high speed use. Very good condition. A bargain for immediate shipment. Write Union Grove Hemp Co., Union Grove, Wis.

PACKAGED H_2S REMOVAL UNITS
We offer prompt shipment on skid-mounted hydrogen sulfide removal units for treating sour gas for pipe line or fuel gas purposes.
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MODERN
DIESEL GENERATING PLANT
300 HP used Fairbanks-Morse Diesel engine, model 32-E-14, serial No. 795310, direct connected to 200 KW. Fairbanks-Morse generator, 3 PF., 3 phase, 60 cycle, 240 volt (can be reconnected to 440 volts). Complete with switch gear, starting equipment, pumps, enclosed cooling system, circuit breaker, silencer and stack.
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DENNY & CLARK
1923 W. North Ave., Chicago 22, Ill.

EQUIPMENT FOR SALE

USED ROTARY AND CABLE TOOL DRILLING TOOLS, WIRE LINES. E. A. KELLY, BOX 861, OKLAHOMA CITY. PHONE 5-6407.

FOR SALE: New skid mounted Beaird-Ingersoll Rand two stage gas compressor plant, 225 horsepower. Suitable for gas lift or pressure boosting service. W. C. McBride, Inc., 1504 Milam Bldg., San Antonio, Texas.

FOR SALE: 5½ Keystone Rig—A1 condition, calf wheels, with or without tools. Would trade for 72 speed Star and pay difference. Boyer Oil Company, Box 35, Iola, Kansas.

NATIONAL "50" Compound Double Drum Rig 126' Cantilever Ideco Mast, 10' substructure, 6,000' 1½" drill pipe, this rig complete and in excellent condition. P.O. Box 403 Sta. B, Bakersfield, California.

ONE new 40' x 40' x 12' corrugated aluminum building; double sliding door; single door and window; steel structure. Located: Bunkie, Louisiana. Anchor Gasoline Corp., Phone 54-5201, Tulsa, Oklahoma.

FOR SALE: 2500' 2⅜" internal up-set drill pipe. Oversize tool joints with Hughes Acme thread OD of tool joints 3⅛". Pipe and tool joints practically new. 700 gal. glass insulated water tank with skids. Just the thing for Northwest and Canadian seismic and core drilling use. Clemens Exploration, Box 136, Princeton, Indiana.

FOR SALE: Two 6-cylinder Hydraulic casing pulling machines. One 7", 5", 3" seven foot jacks; one 5", 3" four foot jacks. All in A-1 condition. Box D-422, The Oil and Gas Journal, Tulsa, Oklahoma.

1 COMPLETE U-10 Unit rotary rig w 3 compounded D13000 engines, 126' mast, 6' substructure, blowout preventor. Fully equipped to start drilling. Equipment in A1 condition. Located at Newcastle, Wyoming. For information contact Kiowa Drilling Company, Inc., 717 Union National Bank Building, Wichita 2, Kans. Telephone 3-8013

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Pipe—valves and fittings.
Boilers.
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Write, Wire, Phone for Listings

DULIEN STEEL PRODUCTS, INC.
of Washington
P. O. BOX 667
COTTON VALLEY, LA.
PHONE: COTTON VALLEY 26

EQUIPMENT FOR SALE

FOR SALE: Near Holdenville, Oklahoma, one angle iron fabricated 5-car steel loading rack. Cities Service Oil Co., Patridge, Bartlesville, Okla.

FOR SALE: 1500 ft. core drilling rig complete with drill pipe and water truck. Box D-426, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: Wilson mogul diesel drilling rig with portable derrick complete. Suitable for 4500' depth. Now running in Bebee Field, Pontotoc County, Oklahoma. Contract available. Lake Oil Company, Ada, Oklahoma.

SWIVEL, Emsco, 6AB, capacity 100 tons, rubber bumper, $750.00, little used. 65 ft. double leg mast, 9x7", Capacity 90 tons, 4-26" sheave crown, 4-26" traveling block, 1000 ft. 6x19 line. A-frame. Raised by draw works. $2,000 f.o.b. New Jersey. American Drilling Company, Fair Haven, N. J.

FOR SALE: 3 New 10,000 bbl. API Columbian bolted steel tanks. 160—8000 & 10,000 gal. tank cars. Darien Corp., 60 E. 42nd St., N.Y., N.Y.

FOR SALE at Barnsdall, Oklahoma, 5" x 16" Gouids Fig. 1585, Vertical Triplex Single Acting Pump, 5,000 BPD, 800± WP. Price $500.00. Suitable for water flood project. Cities Service Oil Co., Patridge, Bartlesville.

12,000' New 2" Galv. Line Pipe, 6 miles 2" used line pipe perfect, 2 miles used 3" 8-thd. line pipe perfect. Molk Petroleum Co., Box 208, El Dorado, Kansas.

FOR SALE: One Wichita 66 Spudder and two D-13000 Caterpillar Diesel Motors. Excellent condition. For further information, call or write Harold Montgomery, Box 748, Farmington, New Mexico.

FOR SALE
(SUBJECT TO PRIOR SALE)

3 Bolted tanks, 2 in original crates and one assembled, (100 Bbl.); 69'-11" 57± Drive Pipe; 170'-10⅜" 41± Drive Pipe; 407'-10⅜" 32.75± Casing 8Rd. Thd. Smls.; 3045'-8" 24± Casing 8Rd. Thd. Smls.; 6286'-7" 23± Casing 8Rd. Thd. Smls.; 8101'-3" 9.20± Tubing Smls.; 1453'-2½" Tubing EUE Smls.; 14,226'-2" 6.40± Regular 10Rd. Thd.; 375'-¾" Pumping rods; 9-5" Orbit Gate Valves; 9-3" Orbit Gate Valves; 3-2" Orbit Gate Valves; 3-2⅞" x 6" Parmco Combination Packer; 1-2⅞" x 6" Larkin Screw Trip Packer; 1-3" x 6" Parmco Packer; 1-2⅞" x 6" Gas Anchor Packer. M. B. Belden Office at 425 2nd St. N. W., Canton 2, Ohio, Phone 4-6147.

3—5000 bbl. API. TANKS, bolted type, Brand new.
6—1000 bbl. API. TANKS, bolted type, Unused, crated for export. 2 ring. Location: Berkeley, Calif.
Reasonable discount allowed if all taken. In stock, 6 good used 10,000 bbl. Tanks.
WILLIAM H. ROSS
1 Drumm St., San Francisco.
Telephone Exbrook 24490.

EQUIPMENT WANTED

WANTED: 1,000 feet of Failing 2⅜" exploration drill pipe and one 7¼ x 10 Gardner-Denver mud pump or equal. Sutter Well Works, Pass Christian, Miss.

WANTED TO BUY: Double drum well servicing unit, spudding attachment, telescope pole, 50 or 60 ft. length mounted on truck. Phone 183-J, Haskell, Okla., or P.O. Box 433, Haskell, Okla.

WANTED to purchase a steel building to use as a garage, width 60 ft. or wider and 100 to 140 ft. long. Give full description and price. Box D-423, The Oil and Gas Journal, Tulsa, Oklahoma.

INTERESTED in small portable double-mast rig, capable of drilling to approximately 2000 feet, with or without drill pipe. Equipment must be in good condition and reasonably priced. Preferably located in Southwest Texas. Contact:

MAKIN DRILLING COMPANY
Box 131, Hobbs, New Mexico, Phone 131

HELP WANTED

HIGH type, responsible executive wanted as Manager Latin-American operations for substantial independent producing company entering foreign operations. Applicant should be college graduate, under 40 years of age, have minimum 15 years' experience in production and drilling work, particularly in high pressure oil and gas well completions. Applicant should speak Spanish fluently, have thorough experience in development Geology, be equipped to prepare and maintain adequate reservoir and engineering studies including repressuring and pressure maintenance. Excellent compensation. When replying, give full details. Our present employes not considered for this position. Box D-364, The Oil and Gas Journal, Tulsa Oklahoma

FOREIGN and Domestic Oil Employment Directory (including late supplement of oil companies and drilling contractors in Western Canada). Over 500 listings in drilling production, refinery, natural gasoline, pipelines, geological, exploration, supplies, manufacturers, services and refinery and pipeline contractors, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla. (Our 30th year)

WANTED: Instrument man with experience in oil refinery and chemical plant instruments. Denver location. State age, experience, and salary expected, in first letter. Box D-373, The Oil and Gas Journal, Tulsa, Oklahoma

MAGNETOMETER party chiefs and operators, domestic and foreign work. Start immediately. Excellent opportunity. Exploration Surveys Incorporated, 5615 Daniels Avenue, Dallas, Texas.

PIPE LINE INSPECTORS needed immediately for arc welding, lay, ditch, paint, lowering-in; only those with main line experience accepted; job located in mid-west. Write full experience. Box D-424, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED! Salesmen in essential areas to call on production superintendents. Write for particulars. The Ball Valve Seat Grinder Co., 102 Jamesville Road, DeWitt, New York (Suburb of Syracuse).

SITUATIONS WANTED

PURCHASING Agent, thoroughly experienced. Also Right of Way procurement and Accounting and Auditing. Age 42. Prefer west coast. Box D-415, The Oil and Gas Journal, Tulsa, Oklahoma.

SUPERVISOR large copper mine, college training, petroleum geology, Sigma Gamma Xi. Desire change location and job. Experienced heavy machinery. Box D-427, The Oil and Gas Journal, Tulsa, Oklahoma.

TREASURER - COMPTROLLER - EXECUTIVE ACCOUNTANT. Fifteen years experience accounting and taxation, CPA, Member AIA, some legal training. Desires change. Box D-419, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—30 yrs. old—2 yrs. roughnecking, 7 yrs. surface and subsurface geological work with major company in Canada, U. S., and South America, desires association with aggressive independent operator, or drilling contractor who is active in wildcatting. Prefer Rocky Mtn. area, or Canada. Pertinent details and references given on request. Box D-402, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT - ENGINEER: Desires position as aid to general or operating executive. Broad experience as accountant, engineer administrative, operating, sales functions all divisions petroleum industry. Good correspondent and contact. Experienced report writer accounting financial, engineering, operating. Procedures studies and investigations. 10 years' specialized experience property valuations, appropriations, budgets, depreciation, depletion, laws, record organization and management, construction projects and costs. Box D-425, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 131, Ph. No. 131, Hobbs, New Mexico.

SITUATIONS WANTED

PETROLEUM ENGINEERING Degree, 1943, Age 30, Married. Experience: Geophysical Surveyor, 3 years; Air Corps, 18 months; 5 years production and drilling. Desire Foreign employment. Now employed. Box D-412, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL Engineer. Age 27, married. Graduate SMU April. Have steel construction experience. Desires position with reliable firm. Prefer location in Southwest. H. B., 2814 Welborn, Lakeside 7483, Dallas, Texas.

LEASE AND DRILLING BLOCKS

SEE A. L. BOWLES, ADA, OKLA., FOR DRILLING DEALS, LEASES, ROYALTIES

TERRY COUNTY, TEXAS—320 acres grass land, part tillable, with ⅜ minerals, one mile Sundown Oilfield, $20 per acre, worth twice asking price. Write or call: A. J. Welborn, 3318 27th Street, Lubbock, Texas, Phone: 3-1531.

PIPELINE making longterm gas contracts or buy production outright, Texas, Louisiana, elsewhere. Inquiries invited from principals, banks, attorneys, geologists, brokers. American Oil Co. Box 38, Houston.

CONTRACTOR with two truck mounted rotaries desires work to 2,500 ft. Will consider proposition with reputable party. Box D-428, The Oil and Gas Journal, Tulsa, Oklahoma.

2000 ACRE gas structure, geology. Market 24c thousand. Town 6000 people. Want drilled. G. Eastman, Milner Hotel, Kansas City, Missouri.

FOR SALE: Oil and Gas Leases and drilling propositions in shallow territory of Allen, Simpson, and Warren Counties, Kentucky. W. P. Harley, Bowling Green, Kentucky.

80-ACRE lease in Artesia pool for sale with drilling obligation—shallow. 640 acres in Loving County, Texas—shallow, Delaware, and deeper; between Wheat Pool and Kyle Pool. Large tract in Panhandle in trend 1½ to 3 miles from a pool of ten producing wells. John P. Mathis, P.O. Box 1106, Amarillo, Texas.

TENNESSEE—88,200 acres timber land—$3.50 per acre, all minerals included. Details: Earl Jester, 12744 Vanowen, North Hollywood, Calif.

SCURRY AND KENT COUNTY MINERALS

Landowner wishes to sell part of his minerals in large ranch. For price and information write:

Box D-430

The Oil and Gas Journal, Tulsa, Okla.

LEASES ROYALTIES

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Inquiries Invited

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Bismarck, North Dakota

(Member National Oil Scouts and Landmen Association. References exchanged).

LEASE AND DRILLING BLOCKS

1916 A. OIL LEASE for $1900 in S. W. Wyoming, near Highway 30, on Piedmont cross structure of Meridian Anticline. Good Geology. R. O. Barnsley, 950 Lincoln Ave., Palo Alto, Calif.

WE BUY PRODUCING

Oil and Gas Leases. Drilling Deals also considered. State complete details in letter to be held in strictest confidence. Box D-380, The Oil and Gas Journal, Tulsa, Oklahoma

WEST TEXAS DRILLING BLOCKS

We have six large drilling blocks in West Texas and New Mexico to sell. Details on request. We also have many cheap minerals and royalties. Navarro Royalties Company, Odessa, Texas.

OIL LEASE FARMOUTS

N. W. Georgia, shallow Pennsylvania formations, sandstone, shale, limestone. Deming, Box 320, Waycross, Ga.

PATENT ATTORNEYS

PATENT Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommell Registered Patent Attorneys, Suite 418 815-15th Street, N.W., Washington 5, D. C.

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1908. Oil-Gas (all states), Business, Real Estate Legal Forms, Leases, Revised With Government Regulations, Commercial Printing. Catalog and Samples on request. Burkhart Printing & Stationery Company, 115 South Cincinnati, Tulsa 3, Oklahoma

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ALUMINUM PAINT—400 5-gallon cans, 480 quarts—Exterior Gilsonite Base, Highly Polished Pure Aluminum Pigment. Waterproof, ideal for tanks, roofs, buildings, equipment. Covers 300 to 400 square feet to the gallon. Distributors Liquidation. Regular price $6.95 gallon. Take any part—$10.00 for 5 gallons, $7 for 12 quarts. Send Check With Order. The National, 606 Walnut, Kansas City, Mo.

WANTED

DRILLING DEALS, proven and semi-proven acreage wanted. Also royalties and producing properties. Send full particulars in first letter to P. O. Box 2161, Cincinnati 1, Ohio.

INVESTMENTS

INVESTMENT—Never before in the oil and gas industry has private capital had the opportunity to play safe and receive a dividend from leasing, drilling, producing. Positive surface deduction eliminates all failures. Owned and directed by one person, expansion has no limit. Details of proof and percentage of dividend for investor on request. A special service to producers seeking positive expansion, fees based on production basis. Box D-429, The Oil and Gas Journal, Tulsa, Oklahoma

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Las Animas Co., Colo. Watered by wells, live springs. Improved. Handle 1200 cattle. Some oil possibilities. Not leased. $10 per acre. Speakman, 1326 E. Kiowa, Colorado Springs, Colo.

PRODUCTION FOR SALE

FOR SALE: 5 Rosiclaire wells in Mattoon Field, Illinois, closely situated—good equipment—producing 13 barrels per day. Box D-418, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

DEEDED ROYALTIES

San Juan Basin & Permian Basin. Write Harry S. Wright, Wright Bldg., Farmington New Mexico.

MONTANA ROYALTIES

Millions of acres now leased by world's major companies, with huge drilling play in prospect. For booklet describing Montana geology and oil development, write Landowners Royalty Company, Box 1225, Great Falls, Montana

WESTERN NEBRASKA

Oil, gas royalty in proven Cheyenne County or nearby wildcat. Write, wire, phone. Smith-Enders Land Co., Kimball, Nebraska.

WE will buy producing or non-producing oil royalties. Standard Security Company, 115 Broadway, New York 6.

EQUIPMENT MEN

(Continued from page 395)

Manning, Maxwell & Moore Elects New Officers

At the annual meeting of the stockholders of Manning, Maxwell & Moore, Inc., the following directors were elected: James S. Alexander, Colby M. Chester, Colby M. Chester, III, Eugene M. Geddes, J. Robert Kelley, Charles W. Littlefield, Henry M. Luscomb, Hamilton Merrill, John E. Minty, Charles A. Moore, III, Eugene M. Moore, Henry S. Moore, and Robert R. Wason.

Following the stockholders' meeting the board of directors elected Colby M. Chester as chairman and Wason was reelected as president. Chester has been a director of the company for 20 years and has served as treasurer. The board also elected Colby M. Chester, III, as treasurer and Miss E. Von Maur as secretary and assistant treasurer.

The following vice presidents also were reelected: Luscomb, Kelley, C. H. Butterfield, Bradford Ellsworth, W. J. Jarrett, Merrill, and Minty.

United Builds Three New Supply Stores

United Supply & Manufacturing Co. has announced the addition of three new oil-supply stores, bringing their total number of outlets to 19, according to H. B. Gutelius, president.

Two of the stores have been located at the centers of new and extensive Oklahoma oil plays, Elk City and Ringwood. The Elk City store will be managed by H. C. Thornton, and the Ringwood store manager is C. W. Parker.

The third new United store is at Homer, La., and is managed by Joe U. Seymer. United has also announced several promotions: W. T. Hughes is representative at large at Oklahoma City; Don Torrance, assistant district manager for Louisiana with headquarters at New Iberia; W. H. (Bob) Huey, assistant district

manager of Oklahoma with headquarters at Pauls Valley; Richard L. Hill, field salesman at Pauls Valley; and W. L. Beckham, store manager at Eunice, La.

Cameron Names Harris Sales Manager Valve Division

JACK HARRIS

AMES BLISS

Cameron Iron Works, Houston, has announced the appointment of Jack Harris to the position of sales manager of the company's newly created Lift Plug Valve Division. For the past several years Harris has been a member of the Cameron engineering and sales departments, coming to Cameron from the J. S. Abercrombie-Harrison Oil Co. refinery at Sweeney, Tex., where he was a department head.

Prior to that time he held the position of a foreman in the Gulf Oil Corp. refinery at Port Arthur after receiving a B.S. degree in chemical engineering from Rice Institute in 1935.

At the same time, Cameron also announced the appointment of Ames Bliss to the position of sales engineer for the LP Valve Division. Bliss, a graduate of Massachusetts Institute of Technology, was a member of the Cameron engineering staff and has done development work on the new Cameron lift plug valve.

Weiland Made Factory Sales Representative for Federal

F. J. Weiland has been appointed factory sales representative for Federal Motor Truck Co. in Wisconsin, Carl Loud, general sales manager, has announced. Weiland will direct dealer relations and sales promotion programs for the company in Wisconsin, upper Michigan, and in northeast Minnesota.

Formerly head of his own truck line, Weiland has for the past 5 years served as a liaison agent for engineering firms in Chicago and Detroit. He brings a 10-year background in sales work to his new position.

Casey Named Manager of Oilwell's El Dorado Store

Tommy W. Casey has been named manager of Oil Well Supply Co.'s El Dorado, Ark., store, succeeding Frank W. Bruner, Jr., who was transferred to Shreveport as district representative. V. J. Waters, central Midwest division manager, has announced.

Casey has been a field representative for Oilwell at El Dorado since 1946. Prior to that time he was a storeman in the El Dorado store. Bruner has been manager of the El Dorado store since May 1949. Previously, he had been connected with Oilwell stores at Greggton, Tex., and Shreveport.

CALENDAR

March

North Texas Oil and Gas Association, Kemp Hotel, Wichita Falls, March 25.

American Chemical Society, Houston meeting, Shamrock Hotel, Houston, March 26-30.

Southern Gas Association, Galveston, Tex., March 27-29.

Western Petroleum Refiners Association, annual meeting, Plaza Hotel, San Antonio, March 27-29.

American Petroleum Institute, Division of Production, Mid-Continent district meeting, Skirvin Hotel, Oklahoma City, March 29-31.

April

American Petroleum Institute, board of directors meeting, Houston, April 3-4.

National Association of Corrosion Engineers, annual conference, Jefferson Hotel, St. Louis, Mo., April 4-7.

American Chemical Society, Philadelphia meeting, Philadelphia, April 9-13.

American Society of Lubrication Engineers, annual convention, Hotel Statler, Detroit, April 10-12.

American Society of Mechanical Engineers, Hotel Statler, Washington, D. C., April 10-14.

Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla., April 11-13.

National Petroleum Association, Hotel Cleveland, Cleveland, Ohio, April 12-14.

American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone Hotel, Casper, Wyo., April 13-14.

American Chemical Society, Detroit meeting, Detroit, April 16-20.

Petroleum Industry Electrical Association and Petroleum Electric Supply Association joint conference, Shamrock Hotel, Houston, April 18-20.

Natural Gasoline Association of America, annual convention, Texas Hotel, Fort Worth, April 24-26.

American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, and Society of Exploration Geophysicists, joint annual meeting, Stevens Hotel, Chicago, April 24-27.

Oil Heat Institute of America and National Oil Heat Exposition, annual meeting, Commercial Museum, Philadelphia, April 24-May 1.

American Petroleum Institute, Division of Production, eastern district meeting, Cleveland Hotel, Cleveland, April 26-28.

May

American Petroleum Institute, Division of Refining, midyear meeting, Hotel Cleveland, Cleveland, May 1-4.

Interstate Oil Compact Commission, spring meeting, Biloxi, Miss., May 4-6.

National Stripper Well Association, Biltmore Hotel, Los Angeles, May 7-9.

Independent Petroleum Association of America, midyear meeting, Biltmore Hotel, Los Angeles, May 7-9.

American Gas Association, Natural Gas Department, spring meeting, Mayo Hotel, Tulsa, May 8-9.

Liquefied Petroleum Gas Association, annual convention, Palmer House, Chicago, May 8-11.

American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles, May 11-12.

American Gas Association, production and chemical conference, Hotel New Yorker, New York, May 22-24.

American Institute of Chemical Engineers, regional meeting, New Ocean House, Swampscott, Mass., May 28-31.

Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Tex., May 29-31.

June

National Oil Scouts and Landmen's Association, Skirvin Tower Hotel, Oklahoma City, June 8-10.

American Society of Mechanical Engineers, oil and gas power division, Lord Baltimore Hotel, Baltimore, June 12-16.

Pennsylvania Grade Crude Oil Association, Hotel William Penn, Pittsburgh, Pa., June 15-16.

American Society of Mechanical Engineers, Hotel Statler, St. Louis, June 19-23.

Canadian Gas Association, annual convention, Manior Richelieu Hotel, Murray, Quebec, Canada, June 20-24.

American Society for Testing Materials, annual meeting Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-30.

American Petroleum Institute, midyear division of production and standardization conference, Brown Palace Hotel, Denver, June 26-30.

August

Interstate Oil Compact Commission, summer meeting, French Lick, Ind., August 3-5.

September

American Society of Mechanical Engineers and Instrument Society of America, Municipal Auditorium, Buffalo, N. Y., September 11-15.

National Petroleum Association, Hotel Traymore, Atlantic City, N. J., September 13-15.

American Society of Mechanical Engineers, petroleum mechanical engineering conference, Roosevelt Hotel, New Orleans, September 25-27.

Instrument Society of America, annual instrument conference and exhibit, Memorial Auditorium, Buffalo, N. Y., September 18-22.

October

American Gas Association, annual convention, Atlantic City, N. J., October 2-6.

Mid-Continent Oil and Gas Association, Texas division, Dallas, October 4-5.

American Association of Oilwell Drilling Contractors, annual meeting Mayo Hotel, Tulsa, October 9-10.

November

American Petroleum Institute, annual meeting, Biltmore and Ambassador Hotels, Los Angeles, November 13-16.

American Society of Mechanical Engineers, Hotel Statler, New York, November 26-December 1.

NOMADS

Tulsa Nomads, third Friday of each month. After Five Room, Tulsa Hotel.

Dallas-Fort Worth Nomads, first Monday of each month, Greater Dallas Club.

Houston Nomads, second Monday of each month. Ye Ole College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month, Jonathan Club.

New York Nomads: April 3, May 10 (annual invitation dinner), all at Louis Sherry's, and June 13-15, golf party, Westchester.

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